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NATIONAL DAM SAFETY PROGRAM. OLD WASHER NUMBER 1 DAM (MO 30478)--ETC(U)
SEP 79 K B KING, J H GRAY, D E WESCOTT DACW43-79-C-0037

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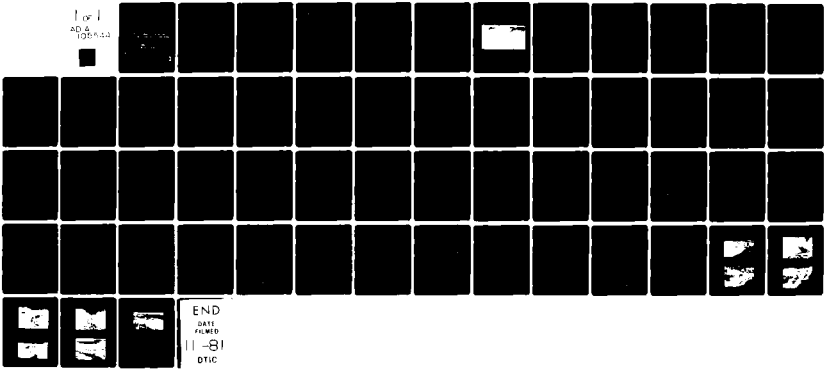

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MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

OLD WASHER NO. 1 DAM
WASHINGTON COUNTY, MISSOURI
MO 30478

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

SEPTEMBER 1979

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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OLD WASHER NO. 1 DAM
WASHINGTON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30478

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
INTERNATIONAL ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
SAN FRANCISCO, CALIFORNIA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

SEPTEMBER 1979

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

21 April 1980

LMSED

SUBJECT: Old Washer No. 1 Dam (MO 30478), Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Old Washer Dam (MO 30478).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District because of the following criteria:

1) Spillway cannot pass 50 percent of the Probable Maximum Flood without significant erosion of the embankment.

2) Significant erosion could result in a failure to the dam.

3) Dam failure significantly increases the potential for loss of life downstream.

For Phase I inspection reports, the extent of the downstream damage zone has been determined assuming that all materials contained by the tailings dam are in a liquid state.

SUBMITTED BY: SIGNED
Chief, Engineering Division
10 JUN 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
10 JUN 1980
Date

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Old Washer No. 1 Dam
State	Missouri
County	Washington
Stream	Unnamed Tributary to Pond Creek
Date of Inspection	7-8 April 1979

Old Washer No. 1 Dam, I.D. No. 30478, owned by IMCO Services, Inc., Bonne Terre, Missouri was inspected by a civil engineer and an engineering geologist from International Engineering Company, Inc., of San Francisco, California. The purpose of the inspection was to assess the general condition of the dam with respect to safety. The assessment is based upon an evaluation of the available data, a visual inspection, and an evaluation of the hydrology and hydraulics of the site in order to determine if the dam poses hazards to human life or property. The dam provides impoundment for barite ore tailings. The impoundment is inactive, but tailings disposal activities may resume in the near future.

Old Washer No. 1 Dam was inspected using the "Recommended Guidelines for Safety Inspection of Dams" furnished by the Department of the Army, Office of the Chief of Engineers. Based on these guidelines, this dam is classified as being of intermediate size. The St. Louis District Corps of Engineers has classified this dam to have a high downstream hazard potential. Failure of this dam could threaten life and property. The estimated damage zone provided by the St. Louis District Corps of Engineers extends approximately 9 miles downstream of the dam. There are several dwellings, 5 railroad bridges, 3 highway bridges and a water supply dam within this damage zone.

The results of the inspection and evaluation indicate that the spillways do not meet the criteria given in the guidelines for a dam with the size and hazard potential of Old Washer No. 1 Dam. As an intermediate size dam with a high hazard potential, the Guidelines specify that the discharge capacity and/or storage capacity should be capable of safely handling the Probable Maximum Flood (PMF) without overtopping the crest. The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

It was calculated that the right abutment spillway can not pass a 100-year flood (a flood having a 1 percent chance of being equalled or exceeded in any 1 year) without significant erosion of the embankment.

It was also calculated that the left abutment spillway can pass a 100-year flood without significant erosion to the embankment. It was estimated that both spillways could pass the 10-year flood (a flood having a 10 percent chance of being equalled or exceeded in a given year) without significant erosion of the embankment; however, both spillways cannot pass 50 percent of the PMF without significant erosion of the embankment. The combined discharge capacity of both spillways can pass 56 percent of the PMF without overtopping the dam.

Severe erosion of the channel walls was observed in both spillway channels and at an access road crossing the left abutment spillway. Corrective action should be taken immediately to stabilize both channels and the road crossing and provide adequate discharge capacity and freeboard to safely handle the PMF.

Seepage and stability analyses of this dam are not available. These studies should be performed by a professional engineer experienced in the design and construction of tailings dams and should be made a matter of record. Based on the results of these analyses, remedial measures may become necessary. Remedial work should be performed under the direction of an engineer experienced in the design and construction of tailings dams.

An inspection and maintenance program should be initiated. Periodic inspections should be made and documented by qualified personnel to observe the performance of the dam and spillway.

It is recommended that the owner take action to correct the deficiencies described.

Kenneth B. King, P.E.

James H. Gray, P.E.

Donald E. Westcott

Overview of Old Washer No. 1 Dam (I.D. No. 30478) from Left Abutment

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OLD WASHER NO. 1 DAM
ID. NO. 30478

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OLD WASHER NO. 1 DAM - ID NO. 30478

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District Corps of Engineers, District Engineer directed that a safety inspection of the Old Washer No. 1 Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to assess the general condition of the dam with respect to safety, based on available data and a visual inspection, to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These Guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) Type of dam - Old Washer No. 1 Dam is an earthfill dam that was used to impound barite ore tailings. The impoundment is formed by a cross valley dam flanked by wing dikes along each abutment.

(2) Spillways - There are two uncontrolled open channel spillways. One spillway is located at each abutment.

b. Location. The dam is located in Washington County, Missouri, as shown in Plate 1. The dam is shown in Plate 2 and is located in Section 10, Township 37 North, Range 3 East.

c. Size Classification. Old Washer No. 1 Dam is greater than 40 feet but less than 100 feet high and is therefore classified as an intermediate size dam in accordance with "Recommended Guidelines for the Safety Inspection of Dams".

d. Hazard Classification. This dam is classified as having a high hazard potential by the St. Louis District Corps of Engineers. The estimated damage zone, as provided by the St. Louis District Corps of Engineers, extends approximately 9 miles downstream. There are several dwellings, 5 railroad bridges, 3 highway bridges, and a water supply dam within this damage zone.

e. Ownership. This dam is owned by:

IMCO Services, Inc.
P.O. Box 188
Bonne Terre, MO 63628

f. Purpose of Dam. The dam impounds tailings resulting from a barite separation and benefication process. Tailings are no longer conveyed to the impoundment. Tailings disposal activities may be resumed sometime in the near future.

g. Design and Construction History. No written design or construction data are available. A starter dam was built by Ray Govero, Mineral Point, Missouri in the spring of 1946. The height of the dam was increased through enlargements made until 1966. The left abutment spillway was constructed in 1969.

h. Normal Operating Procedures. The pond is drained by the spillway at the right abutment. The left abutment spillway functions during periods of runoff. These structures are uncontrolled and do not require operation. No records of operation are presently maintained or are known to exist.

1.3 PERTINENT DATA

a. General. Field surveys were made by Booker Associates, Inc. of St. Louis, Mo., on 17 April 1979. Field measurements are valid as of the dates of inspection and survey.

b. Drainage Area.

2010 acres (3.14 sq. miles) USGS 7.5 minute quadrangle, Mineral Point, Mo., 1958.

c. Discharge at Damsite.

(1) Outlet Pipe - Not applicable.

(2) Total Spillway Discharge -

(a) Maximum discharge experienced at site - No information available.

(b) Total computed discharge at maximum pool elevation -

Left Abutment Spillway - 5040 cfs
Right Abutment Spillway - 1280 cfs

d. Elevation (Feet Above M.S.L.)[1/]

(1) Top of Dam - El. 900.7 to 906.1 feet.

(2) Streambed at Centerline of Dam - El. 850.0 feet.

(3) Maximum Pool - El. 900.7 feet.

(4) Water Level at 17 April 1979 - El. 896.0 feet.

(5) Spillway Crest: Left Spillway - El. 895.0[2/]
Right Spillway - El. 895.0

e. Reservoir. Length of Maximum Pool - 4400 feet.

f. Storage Capacity above El. 895.0 to Top of Dam - 420 acre feet

g. Reservoir Surface Area.

(1) Top of Dam (Maximum Pool) - 98 acres at El. 900.7.

(2) Spillway Crest (Impoundment Level) - 57 acres at El. 895.0.

h. Dam.

(1) Type - Earthfill.

(2) Length of Crest - 930 feet (Main Dam)
2260 feet (Main Dam and wing dikes)

(3) Maximum Height of Dam above Streambed - 54 feet.

(4) Width of Crest - approximately 20 to 30 feet wide.

(5) Side Slopes -

(a) Downstream slope - approximately 1V on 1.2H.

(b) Upstream slope - unknown.

[1/] Elevations are based on a reference elevation of 900.00 feet M.S.L. at the temporary bench mark. This datum was estimated from topographic data presented on the Mineral Point 7.5-minute quadrangle sheet.

[2/] Data estimated from field observation on date of inspection (8 April 1979).

(6) Zoning - The dam appears to be constructed in a manner consistent with prevailing barite dam construction practices. This means that a starter dam was constructed of residual soil, and subsequent enlargements were made using gravel and rock.

(7) Cutoff - There is no written information available to indicate that a cutoff was designed or constructed.

i. Spillways.

(1) Type - The left and right abutment spillways are uncontrolled open channels.

(2) Control Sections -

(a) Left Abutment Spillway - the access road embankment section would function as a broadcrested weir of varying width. (Stations 4+35 to 7+60).

(b) Right Abutment Spillway - Broad irregular trapezoidal opening into the pond at Station 22+48. (see Plate 8).

(3) Crest Elevations -

(a) Left Abutment Spillway - El. 895.0 M.S.L.

(b) Right Abutment Spillway - El. 895.0 M.S.L.

(4) Upstream Channels -

(a) Left Abutment Spillway - shallow channel in eroded tailings

(b) Right Abutment Spillway - none

(5) Downstream Channels -

(a) Left Abutment Spillway - 900 foot long channel discharging into a tributary to Pond Creek about 400 feet downstream of the embankment toe.

(b) Right Abutment Spillway - 1400 foot long channel discharging into a tributary of Pond Creek about 150 feet downstream of the embankment toe.

j. Regulating Outlets. There are no regulating outlets at this dam.

k. Diversion Ditches. There is some diversion of runoff through the left abutment wing dike where three breaches permit runoff to pass into stripmined areas adjacent to the left wing dike and eventually through the left abutment spillway channel.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design drawings or data are known to exist.

2.2 CONSTRUCTION

No written construction data were available. Information concerning construction was provided verbally by Ray Govero, a local contractor, who built the dam in the spring of 1946. According to Mr. Govero, a starter dam was constructed by placing residual soil on bedrock exposed at the bottom of the valley. Vegetation was stripped from the foundation and abutments. No core trench was excavated in the foundation or in the abutments. Residual soil was placed in 1-foot thick layers and was compacted by the hauling trucks and spreading equipment. The slopes of the starter dike were 1 V on 1-1/2 H, and the crest width of the starter dike was 20 to 25 feet. During subsequent operation of the impoundment, three different gradations/of gravel and rock were used to enlarge the dam. These gradations were 3/4-inch to 1/4-inch, 4 inches to 3/4-inch, and sizes greater than 4 inches (bullrock). Various combinations of these materials were used to enlarge the dam. For a period of about 4 years, the minus 3/4-inch material was sold as railroad ballast, and the dam was constructed with gravel and rock of larger gradations during this period. Construction of the dam as it exists was completed in 1966. The spillway at the left abutment was built in 1969 to augment the capacity of the right abutment spillway.

2.3 OPERATION

No records of operation are known to exist.

2.4 EVALUATION

a. Availability. No design or construction records were available. Mr. Ray Govero, constructor of the dam, and Henry Schoo, Mining Engineer for IMCO Services, during conversations provided some information concerning construction and operation of the Old Washer No. 1 Dam.

b. Adequacy. The field surveys and visual inspections documented herein are considered adequate to support the conclusions made in this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available; the lack of this information is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions, including earthquake loads, and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The inspection team consisted of a civil engineer and and engineering geologist from International Engineering Company, Inc. Henry Schoo, Mining Engineer for IMCO Services, Inc., met and escorted the inspection team to the dam and tailings pond. The main dam and wing dikes retain barite ore tailings. An upstream dike (not inspected for this report) almost separates a fresh water pond from the tailings impoundment. Photographs taken during the inspection are included in this report; locations are shown on Plate 9. Photographs numbered 2 and 4 were taken on 20 April 1979.

The inspection was made on 8-9 April; on 11 April a severe rainstorm occurred prior to the survey on 17 April. The site was revisited on 20 April 1979.

b. Project Geology. Bedrock is composed of gray dolomite of the Cambrian age Potosi Formation; exposed outcrops have near vertical primary jointing oriented about N 70° W. Secondary jointing trends about N 60° E and is near vertical. The joints are spaced about 0.5-foot to 2 feet; they are usually closed, although they are occasionally filled with barite crystals. Bedrock outcrops were found along the channel of the left spillway, near the dam toe approximately at Station 9+00, and along the downstream channel. The residual overburden consists predominantly of dark red and brown barite rich clays. The barite occurs within the residual clays as irregularly scattered fragments. Also intermixed are rock fragments of quartz, druse, chert, and dolomite which range in size from sand to boulders.

As much as 20 feet of residual soil overlies the bedrock. Ground water discharge in the left spillway channel was observed at the bedrock-overburden contact.

c. Dam. The plan of the dam is shown on Plate 3; a profile and sections are shown on Plates 4 and 5. Some small trees and brush are growing on the crest, both slopes of the main dam, and on the crest and side slopes of the right wing dike.

Based on visual inspection, no evidence of cracking, settlement, past embankment overtopping or animal burrows was noted on the dam.

Flow in the right abutment spillway has undermined the toe of the right wing dike at Stations 21+00 and 19+00. Other areas along the dam toe at the right spillway were being eroded also. The wing dike near the left abutment from Stations 0+00 to 6+00 consists of a dumped berm of minus 3/4-inch gravel. This dike is breached by runoff channels in three places. This runoff ponds in a mined out area adjacent to the dam from Stations 0+00 to 6+00 and flows out through the left abutment spillway.

Seeps and springs were observed at various locations at the downstream toe. Observed conditions are described below.

Station	Flow (Estimated)	Turbidity
14+21	3 gpm	Clear
12+95	12 gpm	Clear
12+17	1 gpm	Clear
9+62	10 gpm	Clear

Evaluation of foundation condition around the seeps and springs was difficult due to accumulations of greater than 4-inch bullrock from dam enlargement activities collecting at the toe. The ground was saturated at the surface at the seep and spring locations.

The downstream slope of the dam is composed predominantly of plus 3/4-inch material and bullrock (plus 4-inch material). The slope is at or near the angle of repose for these materials. The only upstream slope protection is provided by brush and small trees.

The difference in height between the crest elevation and the adjacent tailings surface varies from 5 feet to over 11 feet.

Both abutments are composed of residual soil. Some strip mining activity has occurred at the left abutment.

d. Appurtenant Structures. Two spillways function at the dam site. Spillway profiles and cross-sections are presented on Plates 4, 5, 6, 7, and 8. One is located in the left abutment and crosses the left wing dike access road at Station 6+20. It flows through a channel cut in residual soil on the left abutment into a hollow to a tributary of Pond Creek. The channel bottom is approximately 10 feet wide which consists of bedrock and is rough and irregular. The sides of the channel are in residual soil and have slopes of approximately 2V on 1H. Erosion of the walls occurs when the spillway operates. A gravel road embankment formed the spillway control section. Significant erosion of this spillway and control section was observed on 20 April 1979.

The other spillway is located on the right abutment adjacent to the dam from Stations 17+00 to 22+50. The right abutment open channel spillway varies in width ranging from 10 to 20 feet. The channel floor is partially armored with cobbles and boulders that are deposited during active erosion of the spillway walls. The channel walls vary in slope from 1V on 1H to nearly vertical in the residual soil. A slide on the left bank of the spillway between Stations 16+63 and 19+45 occurred between the inspection date and the survey date. A beaver dam was observed at the inlet to the right abutment spillway. Subsequent observations on 20 April indicated that this beaver dam had been partially breached. There are no energy dissipators or stilling basins in either spillway. Both spillways drain into the tributary of Pond Creek at varying distances downstream of the dam toe. (See Section 1.3i). No outlet pipes were found at this dam.

Some diversion of runoff occurs through three breaches in the left wing dam from Stations 6+20 to 0+00 and eventually flows into the left abutment spillway downstream of the control section. No other diversion ditches were located. Four old spillways abandoned during the dam enlargement process were observed extending from the base of the main dam.

e. Reservoir Area. No evidence of landslide activity or excessive erosion was observed in the reservoir area.

The site is inactive, and there was no visible evidence of sedimentation at the time of the inspection. There is little potential for backwater flooding at the dam; the only upstream structures are two dwellings that are 25 feet and 75 feet, respectively, above the observed reservoir level.

An approximately one and a half foot high beaver dam was observed in the tailings pond between the upstream dike and the right abutment spillway inlet. This has the effect of raising the fresh water pond level slightly above the adjoining tailings impoundment.

The tailings impoundment consists of red silty clays that were deposited by hydraulic methods during active mine operations. No deposition has occurred in approximately 13 years. Some consolidation of the tailings has probably occurred, primarily in areas immediately adjacent to the dam where drainage can occur. Also, surface zones have dessicated, and small trees and grasses transpire some water from near the surface of the tailings. The watershed is undeveloped, except for two dwellings located upstream from the dam. Some land has been cleared within the watershed to construct a barite separation plant.

f. Downstream Channels. The downstream channels that lead to Pond Creek are heavily forested and essentially undisturbed. Bedrock outcrops were found along the center of the channel. At one half mile from the dam, the channel becomes an intermittent stream where it flows to Pond Creek.

3.2 EVALUATION

Significant erosion, undermining, and slumping of the channel walls of both spillways were observed on 20 April. This erosion presumably resulted from a severe storm on 11 April 1979. The erosion of the spillway channel on the right abutment is encroaching on embankment material and causing sloughing of residual soil in the channel walls adjacent to the wing dike between Stations 22+48 and 17+00. Continued operation of the spillway will cause further erosion and sloughing of channelwall material. This erosion could in time breach the wing dike and reduce the available freeboard. This is a serious problem which adversely affects the safety of the dam. Significant erosion at the left spillway control section and in the channel walls was noted. This erosion restricts access to the crest of the main dam and could eventually encroach on embankment material.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillways are uncontrolled. No regulating procedures exist for the structure.

4.2 MAINTENANCE OF THE DAM

The spillways are inspected regularly. According to Henry Schoo, IMCO Mining Engineer, IMCO personnel remove the low dams that are constructed by a beaver colony at the right abutment spillway. Attempts to maintain the left spillway and prevent further erosion were made by placing tires along the spillway's approach to dissipate flow erosion action and to retain the embankment slopes. Tires were placed to retain embankment material and control erosion in the right spillway.

4.3 MAINTENANCE OF OPERATING FACILITIES

Not applicable.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing mechanical or electro-mechanical warning system. The property owner at the upstream end of the pond monitors the pond water level to prevent flooding of the lower reaches of his property.

4.5 EVALUATION

An inspection program should be expanded so that indications of instability, such as cracks in the dam, sloughing, sudden settlement, erosion of the dam or spillways, or an increase in the volume or turbidity of seepage water, can be monitored. Methods that are presently used to control erosion at the spillways are inadequate. Immediate measures to stabilize the right abutment spillway channel should be implemented. The system for monitoring the water level in the pond appears to be adequate as long as the property owner is present.

SECTION 5 - HYDRAULIC AND HYDROLOGIC ANALYSES

5.1 EVALUATION OF FEATURES

a. Design Data. The significant dimensions of the dam and spillway are presented in Section 1 - Project Information, and also presented in the accompanying field survey drawings, Plates 3 through 8. No hydrologic or hydraulic design information is available.

For this evaluation, the watershed drainage area was obtained from the 1958 7.5-minute USGS Mineral Point quadrangle. The reservoir area-elevation data were obtained from an undated owner supplied topographic map (scale 1 inch = 200 feet with 5-foot contour intervals). The soil group for this watershed is classified as Clarksville Gravelly Loam, the equivalent to a hydrologic soil group B classification, which has a moderate rate of water transmission.

The drainage area at Old Washer No. 1 Dam I.D. No. 30478, as shown on Plate 2, is about 2010 acres (3.14 square miles). Land use and vegetation pattern in the watershed were determined from field observations and aerial photographs of the project area, divided approximately into the following categories.

Type of Cover	Percent of Watershed
Old Tailings	5
Undisturbed Forest	88
Mine disturbance	7

Based on the above, the estimated curve numbers weighted for the entire watershed are CN 50 for the AMC II condition, and CN 70 for the AMC III condition.

The basin parameters such as basin lag time, unit hydrograph, and the probable maximum precipitation are shown in Appendix A.

The impoundment is drained by two spillways, located in the left and right abutments. The left abutment spillway control section is defined by the left wing dike and an access road embankment to the dam crest between Stations 4+35 and 7+60. The low crest elevation for this control section on the access road was El. 895.0 feet as estimated from the field inspection on 8 April 1979. A storm on 11 April eroded the control section on the access road to the elevation surveyed on 17 April 1979. However, this road is required for access to the dam so the control section was evaluated assuming that the access road is rebuilt to original elevation.

The right abutment spillway is adjacent to the right wing dike. The channel alignment is approximately parallel to the right wing dike. The spillway control section was located at the entrance to the channel. The effective crest elevation at the inlet was 895.0 feet.

The cross-sections and the profiles of the spillways, and the profile of the dam crest and the wing dikes, were surveyed and are shown on Plates 3, 4, 6 7 and 8.

Computations of the discharge rating curves for flows over the spillway control sections and the dam crest were made by using the weir formula with a weir coefficient of C = 2.7 for elevations lower than 897.0, and C = 3.0 for higher elevations and above the dam crest. The combined discharge rating curve for flows in the spillways and over the dam crest is shown in Appendix A, under the input data listing as Y4 and Y5 cards, and also in the computer printouts.

The discharge rating for a downstream right abutment spillway channel section at dam baseline Station 19+75 was computed using the Manning formula with the Manning coefficient = 0.04.

The discharge from the right abutment spillway control section was passed through the spillway channel section at baseline Station 19+75 to evaluate the potential for significant erosion.

The storage capacity below El. 895 is considered to be inactive water or tailings storage. The reservoir area-capacity curve data are shown in Appendix A. The capacities, as computed in the computer program by the Conic Method, are the relative capacities above the minimum elevation (El. 895.0) that were entered as input.

b. Experience Data. Recorded rainfall, runoff or other experience data are not available.

c. Visual Observations. Visual observations are presented in Section 3 - Visual Inspections.

d. Overtopping Potential. The 10- and 100-year floods, probable maximum flood (PMF) and floods expressed as a percent of the PMF were computed and routed through the pond and spillways using the discharge rating curve for the spillways. The PMF is defined as the hypothetical flood event that would result from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible at a particular location or region. The Modified Puls Method of spillway routing was employed. For all cases of the spillway flood routing, the starting water surface elevation was set at El. 896, corresponding to the existing water level behind the beaver dam. However, the beaver dam is assumed to be washed away during the early stage of routing and therefore, the rating discharge based on the invert elevation of the Old Washer Dam was used instead of that of the beaver dam.

Results of the overtopping analyses indicate that the spillways are able to pass the 100-year flood. Routing studies indicate that the spillway can also pass about 56 percent of the PMF without overtopping the embankment. However, at 56 percent PMF, the peak spillway outflow is 6271 cfs, with a flow depth of 5.7 feet and flow velocity of about 6.7 feet per second through each control section at the left and right abutments.

A major consideration in evaluating the safety of the dam is assessing the potential for overtopping and the subsequent failure of the embankment as a result of the erosion. Since the spillways are composed of erodible materials, high velocity discharges through the spillways will lead to significant erosion of the spillways even if the dam is not overtopped. In particular, erosion in the right abutment channel has undercut the right wing dike at Station 22+48 to 17+00.

Based on the Corps of Engineers Manual EM 1110-2-1601, "Hydraulic Design of the Flood Control Channels", the maximum permissible velocity for the residual soil found in the spillway sections is about 4.0 feet per second. Using this criterion, the spillway control sections can still pass the 100-year flood but the right abutment channel can only pass the 10-year flood without significant erosion of the spillway. Thus, for determining the spillway erosion potential, flow velocities in the spillway higher than 4.0 feet per second or reservoir water surface elevation exceeding El. 896.5 are considered to produce the effects of significant erosion in the right abutment channel. The results of the overtopping analyses are reported in Appendix A and summarized on the following page.

Flood	Peak Inflow (cfs)	Total Peak Outflow (cfs)	Max. Res. WS Elev. (ft)	Left Abutment Spillway				Right Abutment Spillway			
				Peak Outflow (cfs)	Flow Depth in Control Section (ft)	Velocity in Control Section (ft/sec)	Duration Velocity Over 4 ft/sec (hr)	Peak Outflow (cfs)	Flow Depth in Channel (ft)	Velocity in Channel (ft/sec)	Duration Velocity Over 4 ft/sec (hr)
20% PMF	2,299	2,050	898.6	1490	3.2*	5.3*	6.5	560	6.6*	6.0*	11.5
40% PMF	4,599	4,276	900.1	3276	4.5*	6.3*	9.5	1000	8.8*	6.9*	16.0
50% PMF	5,750	5,620	900.5	4450	4.8*	6.6*	11.0	1170	9.5*	7.2*	18.0
56% PMF	6,438	6,271	900.7	5023	5.0*	6.7*	12.0	1248	9.9*	7.4*	19.0
60% PMF	6,898	6,796	900.8**	5300	5.1*	6.8*	12.0	1290	10.0*	7.5*	20.0
80% PMF	9,198	9,063	901.3**	6400	5.6*	7.1*	14.5	1495	10.9*	7.8*	22.0
PMF	11,497	11,337	901.8**	7449	6.0*	7.4*	16.5	1728	11.5*	8.0*	23.5
100-Yr	563	399	896.6	249	1.5	3.4	0	160	3.5*	4.2*	6.0
10-Yr	247	134	895.9	60	0.8	2.3	0	74	2.0	3.3	0

* These flow depths and velocities are considered to produce the effects of significant erosion.

** Dam overtopped (Minimum Dam Crest, El. 900.7).

Note: Reservoir water surface elevations include the velocity heads corresponding to the velocities computed at the various flow depths for the control section.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions that may adversely affect the structural stability of this dam are discussed in Section 3.

b. Design and Construction Data. No design or construction data pertaining to the structural stability of the dam were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, and lack of this information is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions, including earthquake loads, and made a matter of record.

c. Operating Records. No appurtenant structures are operable at this dam; no records of operations were located.

d. Post-Construction Changes. The dam has been enlarged during intermittent active mine operations between 1946 and 1966, but no written records are available concerning dates of enlargements, design, or materials used. The left abutment spillway was constructed in 1969 and a retaining wall of large equipment tires was constructed in the right abutment spillway channel wall at an unknown date.

e. Seismic Stability. The dam is located in Seismic Zone 2, to which the 1976 Uniform Building Code assigns a "moderate" damage potential. Some ravelling and crest settlement of the embankment gravels and rock could also occur during seismic shaking because the downstream slope is at or near the natural angle of repose of the embankment materials.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The erosion of embankment materials resulting from operation of the right abutment spillway is a serious deficiency. Also, severe erosion was observed in the left abutment spillway and inlet which had restricted vehicle access to the dam. These erosion problems should be corrected immediately to improve the margin of safety. Seepage and stability analyses meeting the requirements of "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. Suggested remedial measures are discussed in Section 7.2 REMEDIAL MEASURES.

b. Adequacy of Information. No written design or construction data were available. Seepage and stability analyses meeting the requirements of "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

Some topographic data for this dam was available. The drainage area measurement was made on the Mineral Point USGS 7.5 minute quadrangle map. Reservoir area-capacity data and slopes were developed using survey measurements and an owner supplied topographic map (scale 1 inch = 200 feet contour interval 5 feet, undated). This data is considered to be adequate for a Phase I analysis; however, the evaluation of overtopping potential is approximate due to the available data.

c. Urgency. The undermining and erosion of embankment materials by the spillway operation is a serious deficiency. Spillway deficiencies should be corrected without undue delay.

d. Necessity for Phase II. No Phase II investigation is recommended, however, additional investigations should be completed as necessary so that seepage and stability analyses can be performed. The investigations should be undertaken by an engineer experienced in the design and construction of tailings dams.

7.2 REMEDIAL MEASURES

a. Spillway. Immediate action should be taken to stabilize the channel wall in the right abutment spillway to control erosion which threatens the integrity of the right wing dike. Also, the access road crossing the left abutment spillway should be rebuilt immediately to ensure access to the dam at all times.

Adequate spillway capacity and freeboard should be provided to safely pass the PMF without overtopping or eroding embankment material. Also, crest width of the wing dikes should be sufficient to maintain sufficient embankment stability when floodwater rises in the impoundment.

b. Inspection Program. The dam should be inspected periodically by an engineer who will observe and record the performance of the dam. The springs and seeps should be monitored as part of the inspection program. Records of these inspections should be maintained, and all maintenance or remedial measures performed at the site should be documented.

c. Stability and Seepage Analyses. These analyses should be performed by an engineer experienced in the design and construction of tailings dams. The main dam could be a relatively porous granular structure above the tailings surface. If the impoundment water level were to rise above the tailings surface, there could be significant seepage through the embankment which could adversely affect the stability of the dam. Included in these analyses, therefore, seepage and stability computations should be performed with the reservoir water surface set at the top of the dam and included in these analyses. Based on the results of these analyses, remedial measures may become necessary. Remedial work should be done under the direction of an engineer experienced in tailings dam design and construction.

HYDROLOGIC AND HYDRAULIC ANALYSES

The hydrologic and hydraulic analyses were accomplished by using the computer program "Flood Hydrograph Package, HEC-1, Dam Safety Investigations Version, July 1978". This program was developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The criteria and methodology used are briefly discussed below:

- Probable Maximum Precipitation (PMP) - The 24-hour PMP was obtained from Hydrometeorological Report No. 33. The 6-hour and the 1-hour depth-duration distributions followed Corps of Engineers EM 1110-2-1411 criteria.

- 100-year and/or 10-year storms - The 24-hour storm amounts and distributions were supplied by Corps of Engineers, St. Louis District, Missouri.

- Unit Hydrograph - The Soil Conservation Service (SCS) curvelinear unit hydrograph method was used. Basin lag time was computed by using the SCS Curve Number Method and equation.

- Hydrologic Soil Group, Antecedent Moisture Condition (AMC) and Curve Number (CN) - The predominant hydrologic soil group for the watershed was obtained from an agricultural soil classification map prepared by the University of Missouri Agricultural Experiment Station. For the PMF and floods expressed as a percent of PMF, AMC III conditions were used. For the 100-year and/or 10-year floods, AMC II conditions were assumed. Watershed CN was estimated from field observations and from aerial photos.

- Reservoir Area-Capacity - Areas were measured from owner-supplied topographic maps. Reservoir elevations and corresponding surface areas were input in the computer program, which determined the reservoir capacities by the Conic Method.

- Reservoir and Spillway Flood Routing - The Modified Puls Method was used for all flood routing through spillway and dam overtopping analyses.

The following pages present the input data listing, the computer program version and its last modification date, together with pertinent computer printouts of results. Definitions of all input and output variable names are presented in the computer program "Users Manual", September 1978, and are not explained herein.

```
A1       OLD WASHER NO 1 DAM  ID NO 30478
A2       HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
A3       PERCENTAGES OF PMF ROUTED THROUGH RESERVOIR
B     144        0       30        0        0        0        0        0        0        0
B1      5
J       1        6        1
J1   .20      .40      .56      .60      .80     1.00
K       0 RUNOFF                           1        1        1
K1       PMF INFLOW TO RESERVOIR
M       1        2     3.14                          1                          1
P       0     26.5      102      120      130
T                                                          -1      -70                .035
M2            1.84
X     -10     -0.1      2.5
K       1 ROUTING                          1        1        1
K1       ROUTING THROUGH RESERVOIR
Y                                     1        1
Y1       :                                                 -896       -1
Y4  895.0    896.1    897.2    898.4    899.6    900.0    900.7    901.8    903.0
Y5        0      157      651     1805     3386     4080     6284    11200    17670
SA       10       47       70      103      118
SE      890      894    896.5    901.5      905
SS    895.0
SD    900.7
K       99
A
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/10/29.
     TIME= 16.35.28.
```

OLD WASHER NO 1 DAM ID NO 30478
HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
PERCENTAGES OF PMF ROUTED THROUGH RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
144	0	30	0	0	0	0	0	0	0
			JOPER	NMT	LROPT	ITRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1

RTIOS=	.20	.40	.50	.60	.80	1.00

A-3

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

PMF INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
QNOFF	0	0	0	1	1	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	3.14	0.00	3.14	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	26.50	102.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-70.00	0.00	.04

CURVE NO = -70.00 WETNESS = -1.00 EFFECT CN = 70.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 1.84

RECESSION DATA
STRTQ= -10.00 QRCSN= -.10 RTIOR= 2.50

UNIT HYDROGRAPH 20 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 1.84 VOL= 1.00

98.	316.	610.	723.	677.	541.	353.	235.	163.	108.
74.	50.	34.	23.	16.	10.	7.	5.	3.	2.

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.09	.00	.09	29.	1.02	12.30	73	0.00	0.00	0.00	89.
1.01	1.00	2	.09	.00	.09	27.	1.02	13.00	74	0.00	0.00	0.00	81.
1.01	1.30	3	.09	.00	.09	27.	1.02	13.30	75	0.00	0.00	0.00	74.
1.01	2.00	4	.09	.00	.09	27.	1.02	14.00	76	0.00	0.00	0.00	68.
1.01	2.30	5	.09	.00	.09	27.	1.02	14.30	77	0.00	0.00	0.00	62.
1.01	3.00	6	.09	.00	.09	27.	1.02	15.00	78	0.00	0.00	0.00	56.
1.01	3.30	7	.09	.00	.09	27.	1.02	15.30	79	0.00	0.00	0.00	52.
1.01	4.00	8	.09	.00	.09	26.	1.02	16.00	80	0.00	0.00	0.00	47.
1.01	4.30	9	.09	.00	.09	25.	1.02	16.30	81	0.00	0.00	0.00	43.
1.01	5.00	10	.09	.00	.09	24.	1.02	17.00	82	0.00	0.00	0.00	39.
1.01	5.30	11	.09	.01	.08	24.	1.02	17.30	83	0.00	0.00	0.00	36.
1.01	6.00	12	.09	.01	.08	24.	1.02	18.00	84	0.00	0.00	0.00	33.
1.01	6.30	13	.40	.08	.32	33.	1.02	18.30	85	0.00	0.00	0.00	30.
1.01	7.00	14	.40	.12	.27	62.	1.02	19.00	86	0.00	0.00	0.00	27.
1.01	7.30	15	.40	.16	.23	125.	1.02	19.30	87	0.00	0.00	0.00	25.
1.01	8.00	16	.40	.19	.20	222.	1.02	20.00	88	0.00	0.00	0.00	23.
1.01	8.30	17	.40	.22	.18	340.	1.02	20.30	89	0.00	0.00	0.00	21.
1.01	9.00	18	.40	.24	.16	466.	1.02	21.00	90	0.00	0.00	0.00	19.
1.01	9.30	19	.40	.26	.14	588.	1.02	21.30	91	0.00	0.00	0.00	17.
1.01	10.00	20	.40	.27	.13	701.	1.02	22.00	92	0.00	0.00	0.00	16.
1.01	10.30	21	.40	.28	.11	801.	1.02	22.30	93	0.00	0.00	0.00	14.
1.01	11.00	22	.40	.29	.10	890.	1.02	23.00	94	0.00	0.00	0.00	13.
1.01	11.30	23	.40	.30	.09	968.	1.02	23.30	95	0.00	0.00	0.00	12.
1.01	12.00	24	.40	.31	.09	1036.	1.03	0.00	96	0.00	0.00	0.00	11.
1.01	12.30	25	1.35	1.11	.24	1172.	1.03	.30	97	0.00	0.00	0.00	10.
1.01	13.00	26	1.35	1.16	.19	1478.	1.03	1.00	98	0.00	0.00	0.00	9.
1.01	13.30	27	1.62	1.44	.18	2046.	1.03	1.30	99	0.00	0.00	0.00	8.
1.01	14.00	28	1.62	1.48	.14	2776.	1.03	2.00	100	0.00	0.00	0.00	8.
1.01	14.30	29	2.03	1.89	.14	3598.	1.03	2.30	101	0.00	0.00	0.00	7.
1.01	15.00	30	2.03	1.92	.11	4437.	1.03	3.00	102	0.00	0.00	0.00	6.
1.01	15.30	31	2.47	2.36	.10	5276.	1.03	3.30	103	0.00	0.00	0.00	6.
1.01	16.00	32	7.81	7.59	.22	6633.	1.03	4.00	104	0.00	0.00	0.00	5.
1.01	16.30	33	1.89	1.88	.04	8557.	1.03	4.30	105	0.00	0.00	0.00	5.
1.01	17.00	34	1.89	1.86	.03	10669.	1.03	5.00	106	0.00	0.00	0.00	4.
1.01	17.30	35	1.49	1.46	.02	11497.	1.03	5.30	107	0.00	0.00	0.00	4.
1.01	18.00	36	1.49	1.47	.02	11195.	1.03	6.00	108	0.00	0.00	0.00	4.
1.01	18.30	37	.13	.13	.00	10055.	1.03	6.30	109	0.00	0.00	0.00	3.
1.01	19.00	38	.13	.13	.00	8282.	1.03	7.00	110	0.00	0.00	0.00	3.
1.01	19.30	39	.13	.13	.00	6539.	1.03	7.30	111	0.00	0.00	0.00	3.
1.01	20.00	40	.13	.13	.00	4954.	1.03	8.00	112	0.00	0.00	0.00	3.
1.01	20.30	41	.13	.13	.00	3606.	1.03	8.30	113	0.00	0.00	0.00	2.
1.01	21.00	42	.13	.13	.00	2599.	1.03	9.00	114	0.00	0.00	0.00	2.
1.01	21.30	43	.13	.13	.00	1929.	1.03	9.30	115	0.00	0.00	0.00	2.
1.01	22.00	44	.13	.13	.00	1481.	1.03	10.00	116	0.00	0.00	0.00	2.
1.01	22.30	45	.13	.13	.00	1172.	1.03	10.30	117	0.00	0.00	0.00	2.
1.01	23.00	46	.13	.13	.00	1060.	1.03	11.00	118	0.00	0.00	0.00	1.
1.01	23.30	47	.13	.13	.00	967.	1.03	11.30	119	0.00	0.00	0.00	1.
1.02	0.00	48	.13	.13	.00	882.	1.03	12.00	120	0.00	0.00	0.00	1.
1.02	.30	49	0.00	0.00	0.00	805.	1.03	12.30	121	0.00	0.00	0.00	1.
1.02	1.00	50	0.00	0.00	0.00	735.	1.03	13.00	122	0.00	0.00	0.00	1.
1.02	1.30	51	0.00	0.00	0.00	670.	1.03	13.30	123	0.00	0.00	0.00	1.
1.02	2.00	52	0.00	0.00	0.00	612.	1.03	14.00	124	0.00	0.00	0.00	1.
1.02	2.30	53	0.00	0.00	0.00	558.	1.03	14.30	125	0.00	0.00	0.00	1.
1.02	3.00	54	0.00	0.00	0.00	509.	1.03	15.00	126	0.00	0.00	0.00	1.
1.02	3.30	55	0.00	0.00	0.00	465.	1.03	15.30	127	0.00	0.00	0.00	1.
1.02	4.00	56	0.00	0.00	0.00	424.	1.03	16.00	128	0.00	0.00	0.00	1.

1.02	4.30	57	0.00	0.00	0.00	387.	1.03	16.30	129	0.00	0.00	0.00	1.
1.02	5.00	58	0.00	0.00	0.00	353.	1.03	17.00	130	0.00	0.00	0.00	0.
1.02	5.30	59	0.00	0.00	0.00	322.	1.03	17.30	131	0.00	0.00	0.00	0.
1.02	6.00	60	0.00	0.00	0.00	294.	1.03	18.00	132	0.00	0.00	0.00	0.
1.02	6.30	61	0.00	0.00	0.00	268.	1.03	18.30	133	0.00	0.00	0.00	0.
1.02	7.00	62	0.00	0.00	0.00	245.	1.03	19.00	134	0.00	0.00	0.00	0.
1.02	7.30	63	0.00	0.00	0.00	223.	1.03	19.30	135	0.00	0.00	0.00	0.
1.02	8.00	64	0.00	0.00	0.00	204.	1.03	20.00	136	0.00	0.00	0.00	0.
1.02	8.30	65	0.00	0.00	0.00	186.	1.03	20.30	137	0.00	0.00	0.00	0.
1.02	9.00	66	0.00	0.00	0.00	170.	1.03	21.00	138	0.00	0.00	0.00	0.
1.02	9.30	67	0.00	0.00	0.00	155.	1.03	21.30	139	0.00	0.00	0.00	0.
1.02	10.00	68	0.00	0.00	0.00	141.	1.03	22.00	140	0.00	0.00	0.00	0.
1.02	10.30	69	0.00	0.00	0.00	129.	1.03	22.30	141	0.00	0.00	0.00	0.
1.02	11.00	70	0.00	0.00	0.00	118.	1.03	23.00	142	0.00	0.00	0.00	0.
1.02	11.30	71	0.00	0.00	0.00	107.	1.03	23.30	143	0.00	0.00	0.00	0.
1.02	12.00	72	0.00	0.00	0.00	98.	1.04	0.00	144	0.00	0.00	0.00	0.
									SUM	34.45	29.96	4.49	128602.
										(875.)(	761.)(	114.)(	3641.60)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11497.	7641.	2619.	893.	128584.
CMS	326.	216.	74.	25.	3641.
INCHES		22.64	31.04	31.74	31.74
MM		574.99	788.41	806.31	806.31
AC-FT		3789.	5195.	5313.	5313.
THOUS CU M		4674.	6408.	6554.	6554.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTING	1	0	0	1	1	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-896.	-1

STAGE	895.00	896.10	897.20	898.40	899.60	900.00	900.70	901.80	903.00
FLOW	0.00	157.00	651.00	1805.00	3386.00	4080.00	6284.00	11200.00	17670.00
SURFACE AREA=	10.	47.	70.	103.	118.				
CAPACITY=	0.	105.	230.	680.	1067.				
ELEVATION=	890.	894.	897.	902.	905.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
895.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
900.7	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

133.	124.	115.	107.	100.	93.	87.	82.	77.	72.
68.	64.	60.	59.	62.	73.	92.	120.	155.	271.
384.	490.	590.	709.	874.	1060.	1348.	1769.	2457.	3202.
4107.	5617.	7398.	9516.	10995.	11337.	10655.	9249.	7489.	5883.
4580.	3590.	2931.	2341.	1841.	1547.	1333.	1168.	1035.	925.
833.	753.	682.	634.	601.	566.	530.	493.	458.	423.
390.	359.	330.	303.	277.	254.	232.	211.	193.	176.
160.	153.	148.	143.	137.	132.	126.	120.	114.	109.
103.	97.	92.	87.	82.	77.	72.	68.	63.	59.
55.	52.	48.	45.	42.	39.	36.	34.	31.	29.
27.	25.	23.	21.	20.	18.	17.	16.	14.	13.
12.	11.	10.	10.	9.	8.	8.	7.	6.	6.
5.	5.	5.	4.	4.	4.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	1.	1.	1.	1.
1.	1.	1.	1.						

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .40	RATIO 3 .56	RATIO 4 .60	RATIO 5 .80	RATIO 6 1.00
HYDROGRAPH AT	UNOFF	3.14	1	2299.	4599.	6438.	6898.	9198.	11497.
	(	8.13)	(	65.11)(	130.22)(	182.31)(	195.34)(	260.45)(	325.56)(
ROUTED TO	OUTING	3.14	1	2050.	4276.	6271.	6796.	9063.	11337.
	(	8.13)	(	58.05)(	121.08)(	177.58)(	192.44)(	256.65)(	321.03)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ... .

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	896.00	895.00	900.70
STORAGE	216.	156.	600.
OUTFLOW	143.	0.	6284.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	898.59	0.00	410.	2050.	0.00	18.50	0.00
.40	900.06	0.00	549.	4276.	0.00	18.00	0.00
.56	900.70	0.00	600.	6271.	0.00	18.00	0.00
.60	900.81	.11	611.	6796.	1.50	18.00	0.00
.80	901.32	.62	662.	9063.	2.50	18.00	0.00
1.00	901.83	1.13	714.	11337.	3.50	18.00	0.00

```
A1       OLD WASHER NO 1 DAM  ID NO 30478
A2       HEC-1 PHASE 1  DAM SAFETY INVESTIGATION
A3       100-YR FLOOD ROUTED THROUGH RESERVOIR
B     144                30                                    0
B1      3                                              1       1
K       0 RUNOFF                                  1    1       1
K1       100-YR FLOOD INFLOW TO RESERVOIR
M        0        2    3.14
O       48
O1   .042     .042     .042     .042     .042     .042     .042     .042     .042     .042
O1   .042     .042     .084     .084     .084     .084     .084     .084     .132     .132
O1   .132     .186     .366    1.449    1.853     .366     .186     .132     .132     .132
O1   .084     .084     .084     .084     .084     .084     .042     .042     .042     .042
O1   .042     .042     .042     .042     .042     .042     .042     .042
T                                                          -1      -50              .035
W2             3.06
X      -10     -0.1      2.5
K       1 ROUTING                                 1    1       1
K1       ROUTING THROUGH RESERVOIR
Y                                                 1    1
Y1      1                                                    -896      -1
Y4  895.0    896.1    897.2    898.4    899.6    900.0    900.7    901.8    903.0
Y5      0      157      651     1805     3386     4080     6284    11200    17670
$A     10       47       70      103      118
$E    890      894    896.5    901.5      905
$$  895.0
$D  900.7
K      99
A
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/09/13.
     TIME= 11.05.43.
```

OLD WASHER NO 1 DAM ID NO 30478
HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
100-YR FLOOD ROUTED THROUGH RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
144	0	30	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			3	0	0	0			

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

100-YR FLOOD INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
UNOFF	0	0	0	1	1	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	3.14	0.00	3.14	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
48	0.00	0.00	0.00

PRECIP PATTERN

.04	.04	.04	.04	.04	.04	.04	.04	.04	.04
.04	.04	.08	.08	.08	.08	.08	.08	.13	.13
.13	.19	.37	1.45	1.85	.37	.19	.13	.13	.13
.08	.08	.08	.08	.08	.08	.04	.04	.04	.04
.04	.04	.04	.04	.04	.04	.04	.04		

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-50.00	0.00	.04

CURVE NO = -50.00 WETNESS = -1.00 EFFECT CN = 50.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 3.06

RECESSION DATA
STRTQ= -10.00 QRCSN= -.10 RTIOR= 2.50

UNIT HYDROGRAPH 33 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 3.06 VOL= 1.00

30.	88.	181.	305.	403.	454.	455.	423.	372.	306.

	228.	175.	137.	109.	86.	66.	52.	41.	32.	24.
	19.	15.	12.	9.	7.	6.	5.	4.	3.	2.
	1.	1.	0.							

0						END-OF-PERIOD FLOW						
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.30	1	.04	.00	.04	29.	1.02	12.30	73	0.00	0.00	0.00	11.
1.01	1.00	2	.04	.00	.04	26.	1.02	13.00	74	0.00	0.00	0.00	10.
1.01	1.30	3	.04	.00	.04	24.	1.02	13.30	75	0.00	0.00	0.00	9.
1.01	2.00	4	.04	.00	.04	23.	1.02	14.00	76	0.00	0.00	0.00	8.
1.01	2.30	5	.04	.00	.04	21.	1.02	14.30	77	0.00	0.00	0.00	7.
1.01	3.00	6	.04	.00	.04	20.	1.02	15.00	78	0.00	0.00	0.00	7.
1.01	3.30	7	.04	.00	.04	19.	1.02	15.30	79	0.00	0.00	0.00	6.
1.01	4.00	8	.04	.00	.04	19.	1.02	16.00	80	0.00	0.00	0.00	6.
1.01	4.30	9	.04	.00	.04	18.	1.02	16.30	81	0.00	0.00	0.00	5.
1.01	5.00	10	.04	.00	.04	17.	1.02	17.00	82	0.00	0.00	0.00	5.
1.01	5.30	11	.04	.00	.04	16.	1.02	17.30	83	0.00	0.00	0.00	4.
1.01	6.00	12	.04	.00	.04	15.	1.02	18.00	84	0.00	0.00	0.00	4.
1.01	6.30	13	.08	.00	.08	15.	1.02	18.30	85	0.00	0.00	0.00	4.
1.01	7.00	14	.08	.00	.08	14.	1.02	19.00	86	0.00	0.00	0.00	3.
1.01	7.30	15	.08	.00	.08	14.	1.02	19.30	87	0.00	0.00	0.00	3.
1.01	8.00	16	.08	.00	.08	14.	1.02	20.00	88	0.00	0.00	0.00	3.
1.01	8.30	17	.08	.00	.08	14.	1.02	20.30	89	0.00	0.00	0.00	2.
1.01	9.00	18	.08	.00	.08	14.	1.02	21.00	90	0.00	0.00	0.00	2.
1.01	9.30	19	.13	.00	.13	14.	1.02	21.30	91	0.00	0.00	0.00	2.
1.01	10.00	20	.13	.00	.13	14.	1.02	22.00	92	0.00	0.00	0.00	2.
1.01	10.30	21	.13	.00	.13	15.	1.02	22.30	93	0.00	0.00	0.00	2.
1.01	11.00	22	.19	.01	.18	16.	1.02	23.00	94	0.00	0.00	0.00	2.
1.01	11.30	23	.37	.01	.35	17.	1.02	23.30	95	0.00	0.00	0.00	1.
1.01	12.00	24	1.45	.22	1.23	24.	1.03	0.00	96	0.00	0.00	0.00	1.
1.01	12.30	25	1.85	.67	1.18	58.	1.03	.30	97	0.00	0.00	0.00	1.
1.01	13.00	26	.37	.17	.20	124.	1.03	1.00	98	0.00	0.00	0.00	1.
1.01	13.30	27	.19	.09	.10	226.	1.03	1.30	99	0.00	0.00	0.00	1.
1.01	14.00	28	.13	.07	.07	352.	1.03	2.00	100	0.00	0.00	0.00	1.
1.01	14.30	29	.13	.07	.06	462.	1.03	2.30	101	0.00	0.00	0.00	1.
1.01	15.00	30	.13	.07	.06	534.	1.03	3.00	102	0.00	0.00	0.00	1.
1.01	15.30	31	.08	.04	.04	563.	1.03	3.30	103	0.00	0.00	0.00	1.
1.01	16.00	32	.08	.04	.04	558.	1.03	4.00	104	0.00	0.00	0.00	1.
1.01	16.30	33	.08	.04	.04	528.	1.03	4.30	105	0.00	0.00	0.00	1.
1.01	17.00	34	.08	.05	.04	477.	1.03	5.00	106	0.00	0.00	0.00	1.
1.01	17.30	35	.08	.05	.04	416.	1.03	5.30	107	0.00	0.00	0.00	0.
1.01	18.00	36	.08	.05	.04	367.	1.03	6.00	108	0.00	0.00	0.00	0.
1.01	18.30	37	.04	.02	.02	329.	1.03	6.30	109	0.00	0.00	0.00	0.
1.01	19.00	38	.04	.02	.02	297.	1.03	7.00	110	0.00	0.00	0.00	0.
1.01	19.30	39	.04	.02	.02	269.	1.03	7.30	111	0.00	0.00	0.00	0.
1.01	20.00	40	.04	.02	.02	242.	1.03	8.00	112	0.00	0.00	0.00	0.
1.01	20.30	41	.04	.02	.02	218.	1.03	8.30	113	0.00	0.00	0.00	0.
1.01	21.00	42	.04	.02	.02	196.	1.03	9.00	114	0.00	0.00	0.00	0.
1.01	21.30	43	.04	.02	.02	177.	1.03	9.30	115	0.00	0.00	0.00	0.
1.01	22.00	44	.04	.02	.02	160.	1.03	10.00	116	0.00	0.00	0.00	0.
1.01	22.30	45	.04	.02	.02	146.	1.03	10.30	117	0.00	0.00	0.00	0.
1.01	23.00	46	.04	.02	.02	135.	1.03	11.00	118	0.00	0.00	0.00	0.
1.01	23.30	47	.04	.02	.02	127.	1.03	11.30	119	0.00	0.00	0.00	0.
1.02	0.00	48	.04	.02	.02	121.	1.03	12.00	120	0.00	0.00	0.00	0.
1.02	.30	49	0.00	0.00	0.00	115.	1.03	12.30	121	0.00	0.00	0.00	0.
1.02	1.00	50	0.00	0.00	0.00	109.	1.03	13.00	122	0.00	0.00	0.00	0.
1.02	1.30	51	0.00	0.00	0.00	102.	1.03	13.30	123	0.00	0.00	0.00	0.
1.02	2.00	52	0.00	0.00	0.00	92.	1.03	14.00	124	0.00	0.00	0.00	0.
1.02	2.30	53	0.00	0.00	0.00	81.	1.03	14.30	125	0.00	0.00	0.00	0.

1.02	3.00	54	0.00	0.00	0.00	68.	1.03	15.00	126	0.00	0.00	0.00	0.
1.02	3.30	55	0.00	0.00	0.00	56.	1.03	15.30	127	0.00	0.00	0.00	0.
1.02	4.00	56	0.00	0.00	0.00	51.	1.03	16.00	128	0.00	0.00	0.00	0.
1.02	4.30	57	0.00	0.00	0.00	47.	1.03	16.30	129	0.00	0.00	0.00	0.
1.02	5.00	58	0.00	0.00	0.00	43.	1.03	17.00	130	0.00	0.00	0.00	0.
1.02	5.30	59	0.00	0.00	0.00	39.	1.03	17.30	131	0.00	0.00	0.00	0.
1.02	6.00	60	0.00	0.00	0.00	35.	1.03	18.00	132	0.00	0.00	0.00	0.
1.02	6.30	61	0.00	0.00	0.00	32.	1.03	18.30	133	0.00	0.00	0.00	0.
1.02	7.00	62	0.00	0.00	0.00	30.	1.03	19.00	134	0.00	0.00	0.00	0.
1.02	7.30	63	0.00	0.00	0.00	27.	1.03	19.30	135	0.00	0.00	0.00	0.
1.02	8.00	64	0.00	0.00	0.00	25.	1.03	20.00	136	0.00	0.00	0.00	0.
1.02	8.30	65	0.00	0.00	0.00	22.	1.03	20.30	137	0.00	0.00	0.00	0.
1.02	9.00	66	0.00	0.00	0.00	20.	1.03	21.00	138	0.00	0.00	0.00	0.
1.02	9.30	67	0.00	0.00	0.00	19.	1.03	21.30	139	0.00	0.00	0.00	0.
1.02	10.00	68	0.00	0.00	0.00	17.	1.03	22.00	140	0.00	0.00	0.00	0.
1.02	10.30	69	0.00	0.00	0.00	16.	1.03	22.30	141	0.00	0.00	0.00	0.
1.02	11.00	70	0.00	0.00	0.00	14.	1.03	23.00	142	0.00	0.00	0.00	0.
1.02	11.30	71	0.00	0.00	0.00	13.	1.03	23.30	143	0.00	0.00	0.00	0.
1.02	12.00	72	0.00	0.00	0.00	12.	1.04	0.00	144	0.00	0.00	0.00	0.
									SUM	7.21	1.98	5.24	8718.
										(183.)(	50.)(	133.)(	246.87)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	563.	428.	171.	60.	8708.
CMS	16.	12.	5.	2.	247.
INCHES		1.27	2.02	2.15	2.15
MM		32.18	51.32	54.61	54.61
AC-FT		212.	338.	360.	360.
THOUS CU M		262.	417.	444.	444.

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTING	1	0	0	1	1	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

	NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	-896.	-1

STAGE	895.00	896.10	897.20	898.40	899.60	900.00	900.70	901.80	903.00
FLOW	0.00	157.00	651.00	1805.00	3386.00	4080.00	6284.00	11200.00	17670.00
SURFACE AREA=	10.	47.	70.	103.	118.				
CAPACITY=	0.	105.	250.	680.	1067.				
ELEVATION=	890.	894.	897.	902.	905.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
895.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
900.7	0.0	0.0	0.

PEAK OUTFLOW IS 399. AT TIME 17.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	399.	339.	168.	70.	10087.
CMS	11.	10.	5.	2.	286.
INCHES		1.00	1.99	2.49	2.49
MM		25.51	50.58	63.25	63.25
AC-FT		168.	333.	417.	417.
THOUS CU M		207.	411.	514.	514.

RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

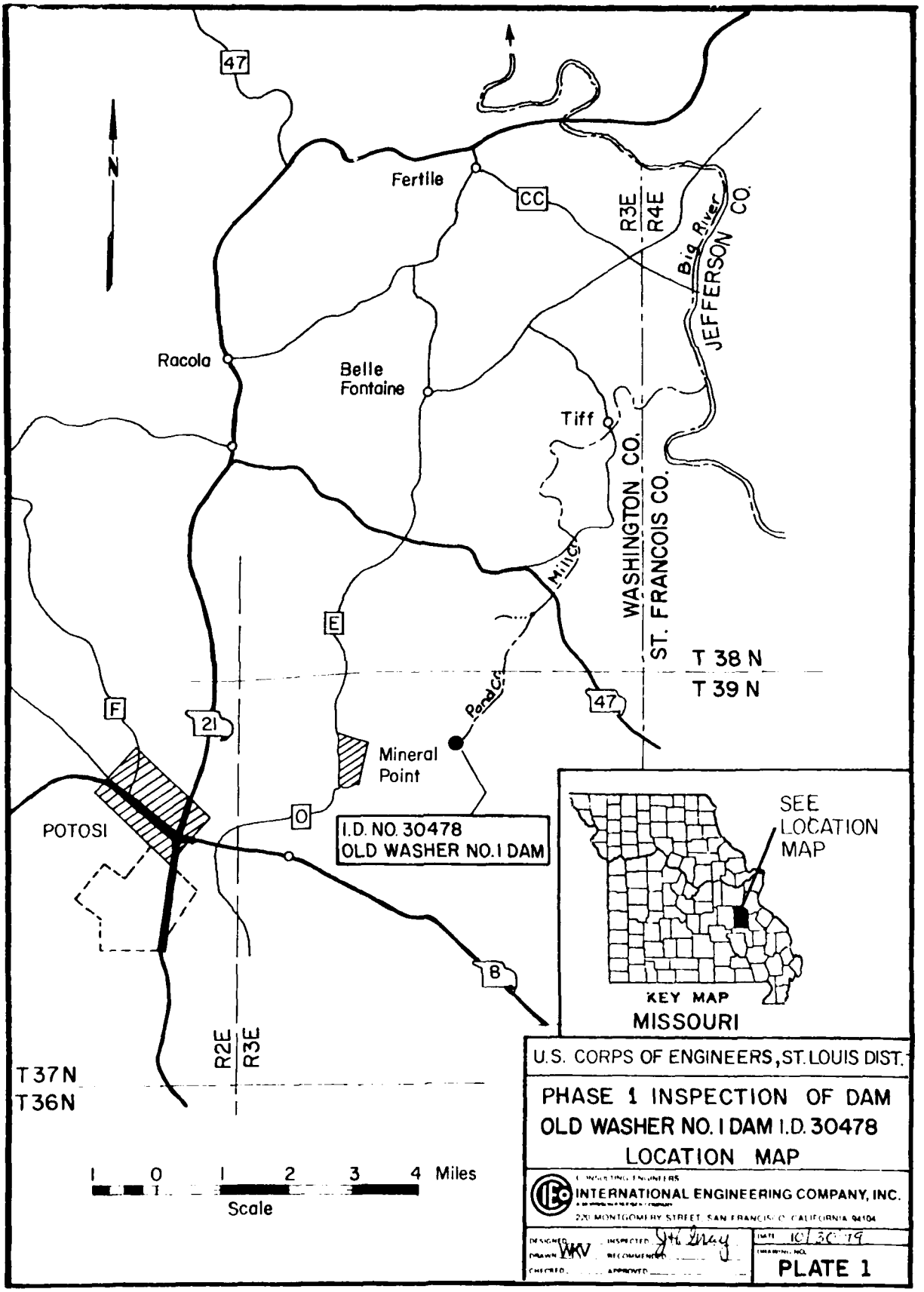
		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	UNOFF	563.	428.	171.	60.	3.14
		(15.95)(	12.11)(	4.83)(	1.71)(	8.13)
ROUTED TO	OUTING	399.	339.	168.	70.	3.14
		(11.29)(	9.60)(	4.76)(	1.98)(	8.13)

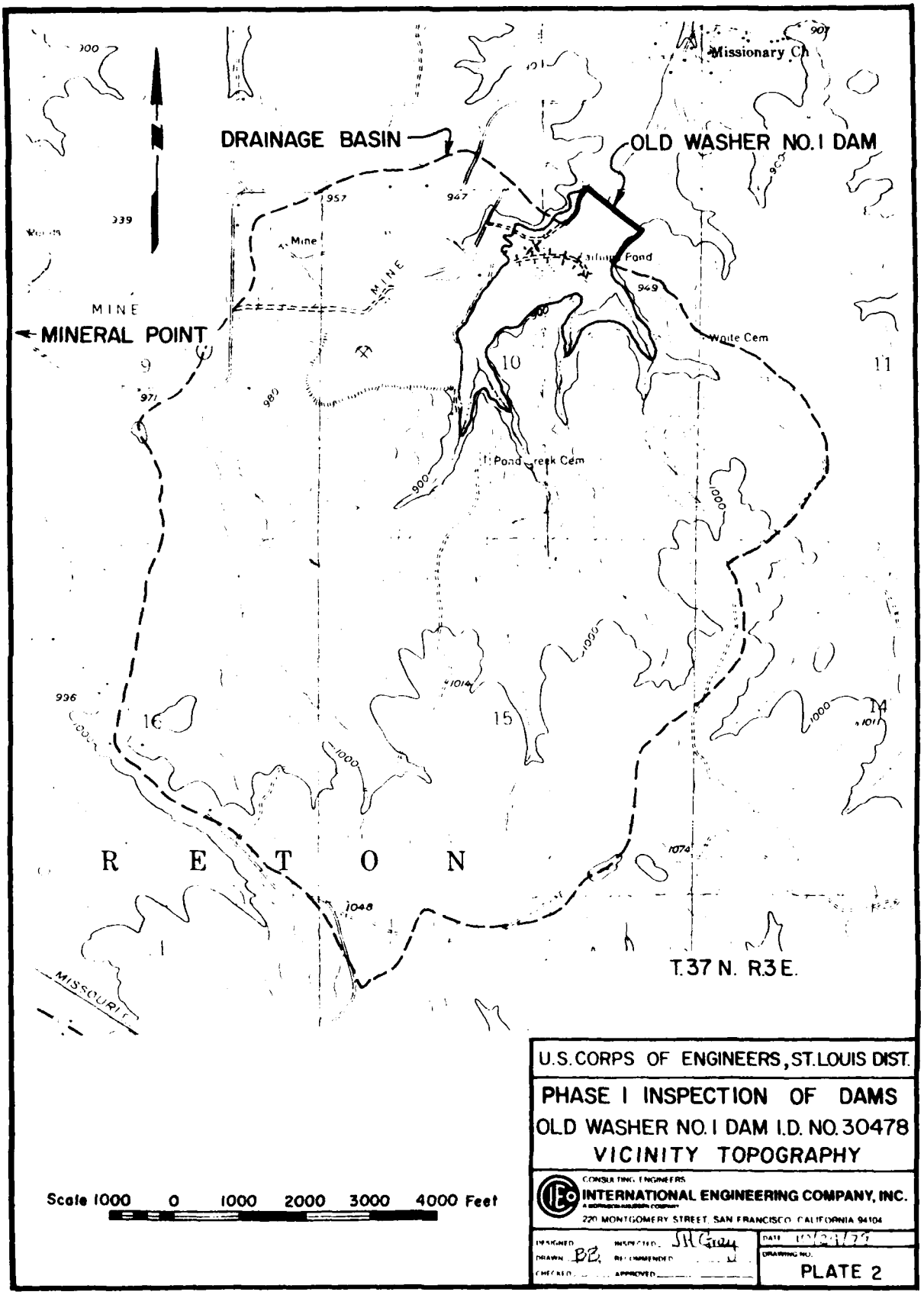
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 100-YEAR

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	896.00	895.00	900.70
STORAGE	216.	156.	600.
OUTFLOW	143.	0.	6284.

MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
896.64	0.00	260.	399.	0.00	17.50	0.00


47
N
Fertile
CC
R3E
R4E
Big River
JEFFERSON CO.
Racola
Belle
Fontaine
Tiff
WASHINGTON CO.
ST. FRANCOIS CO.
Mill Cr.
E
T 38 N
T 39 N
F
21
Pond Cr.
47
Mineral
Point
POTOSI
O
I.D. NO. 30478
OLD WASHER NO. I DAM
SEE
LOCATION
MAP
KEY MAP
MISSOURI
B
R2E
R3E
T37N
T36N
0 1 2 3 4 Miles
Scale
U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.
PHASE 1 INSPECTION OF DAM
OLD WASHER NO. I DAM I.D. 30478
LOCATION MAP
INTERNATIONAL ENGINEERING COMPANY, INC.
220 MONTGOMERY STREET, SAN FRANCISCO, CALIFORNIA 94104
DESIGNED
DRAWN WKV
CHECKED
INSPECTED
RECOMMENDED
APPROVED
DATE 10/30/79
PLATE 1



U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.

PHASE I INSPECTION OF DAMS

OLD WASHER NO. 1 DAM I.D. NO. 30478

VICINITY TOPOGRAPHY

CONSULTING ENGINEERS

INTERNATIONAL ENGINEERING COMPANY, INC.

220 MONTGOMERY STREET, SAN FRANCISCO, CALIFORNIA 94104

DESIGNED BB INSPECTED SH Gray DATE 12/23/77

DRAWN BB RECOMMENDED

CHECKED APPROVED

DRAWING NO. PLATE 2

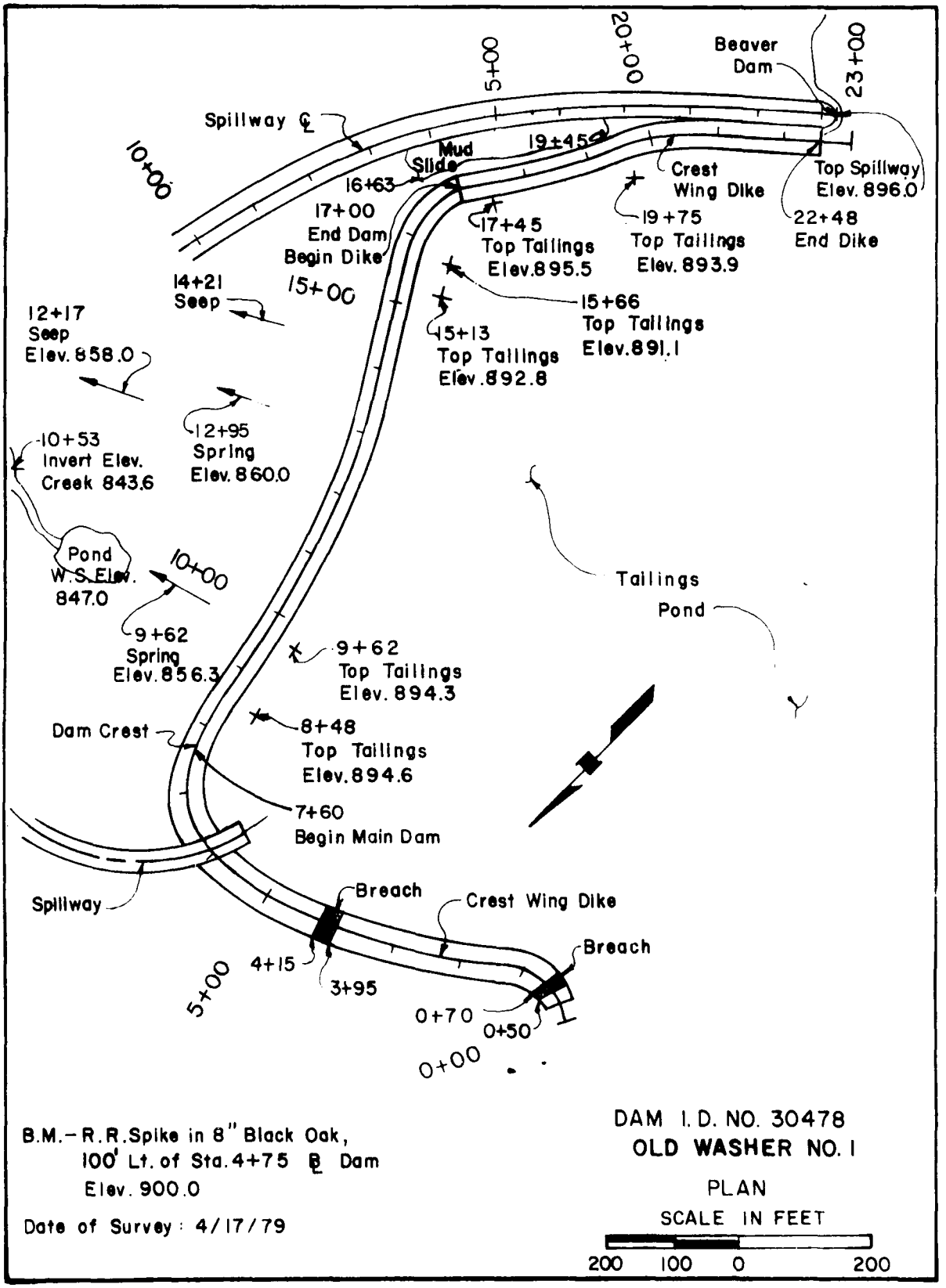
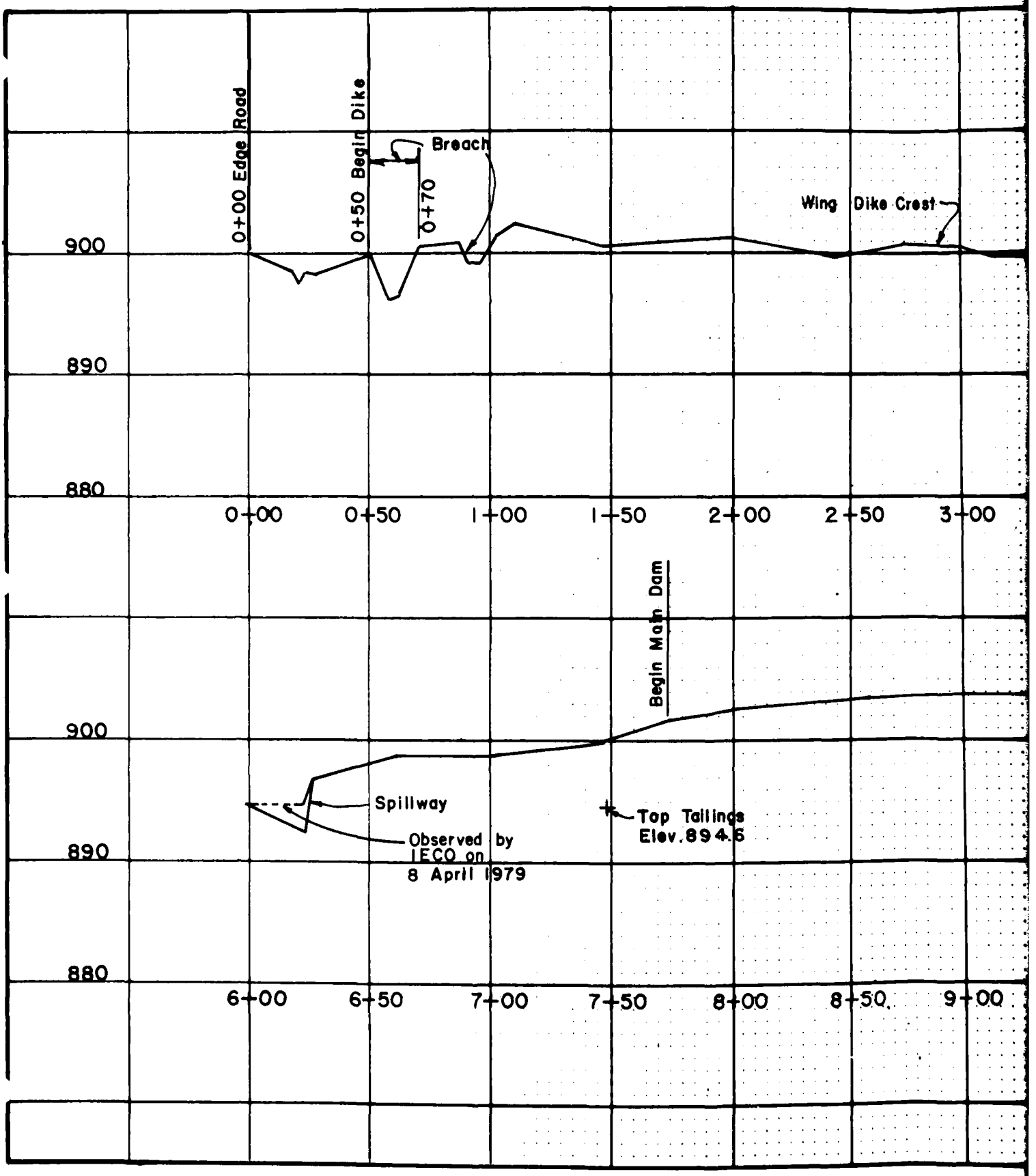
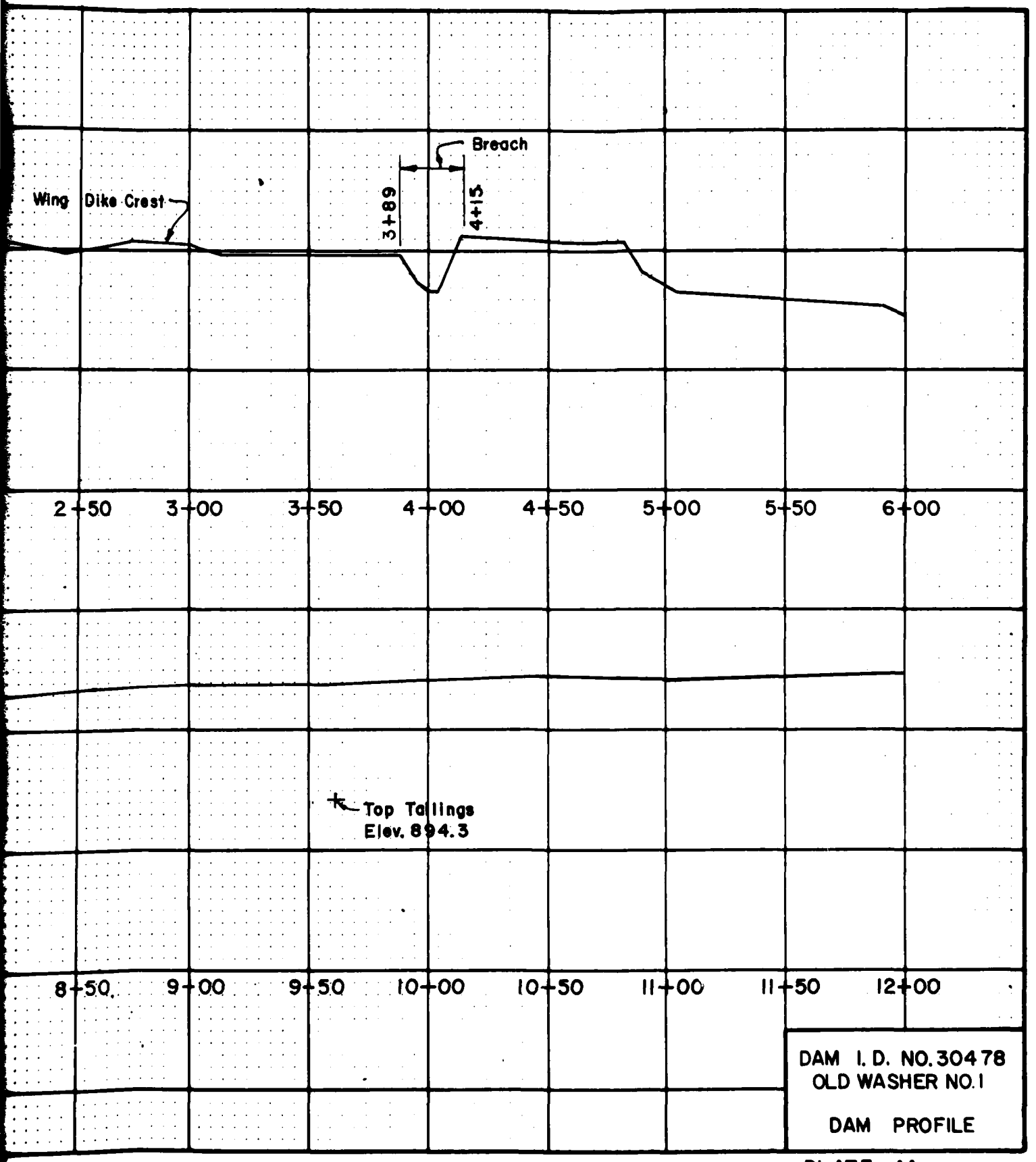

5+00
20+00
Beaver Dam
23+00
Spillway ℄
10+00
Mud Slide
19+45
16+63
17+00
End Dam
Begin Dike
15+00
Crest Wing Dike
Top Spillway Elev. 896.0
17+45
Top Tailings
Elev. 895.5
19+75
Top Tailings
Elev. 893.9
22+48
End Dike
14+21
Seep
12+17
Seep
Elev. 858.0
15+66
Top Tailings
Elev. 891.1
15+13
Top Tailings
Elev. 892.8
12+95
Spring
Elev. 860.0
10+53
Invert Elev.
Creek 843.6
Pond
W.S. Elev.
847.0
10+00
Tailings
Pond
9+62
Spring
Elev. 856.3
9+62
Top Tailings
Elev. 894.3
Dam Crest
8+48
Top Tailings
Elev. 894.6
7+60
Begin Main Dam
Spillway
Breach
Crest Wing Dike
Breach
5+00
4+15
3+95
0+70
0+50
0+00
B.M. – R.R. Spike in 8" Black Oak,
100' Lt. of Sta. 4+75 ℄ Dam
Elev. 900.0
Date of Survey: 4/17/79
DAM I. D. NO. 30478
OLD WASHER NO. 1
PLAN
SCALE IN FEET
200 100 0 200

PLATE 3


0+00 Edge Road
0+50 Begin Dike
0+70
Breach
Wing Dike Crest
900
890
880
0+00
0+50
1+00
1+50
2+00
2+50
3+00
Begin Main Dam
900
Spillway
Observed by IECO on 8 April 1979
Top Tailings Elev. 894.6
890
880
6+00
6+50
7+00
7+50
8+00
8+50
9+00

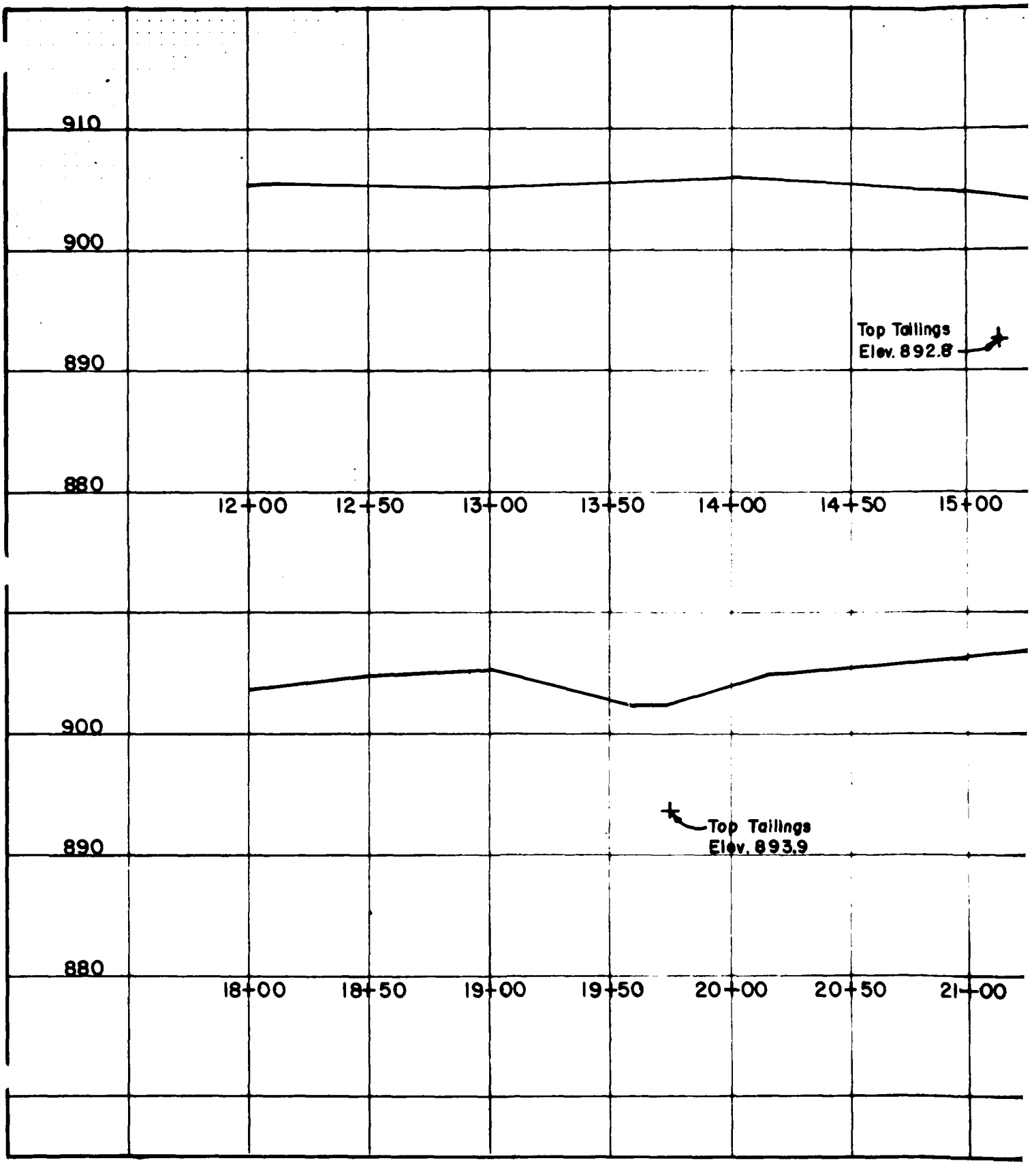


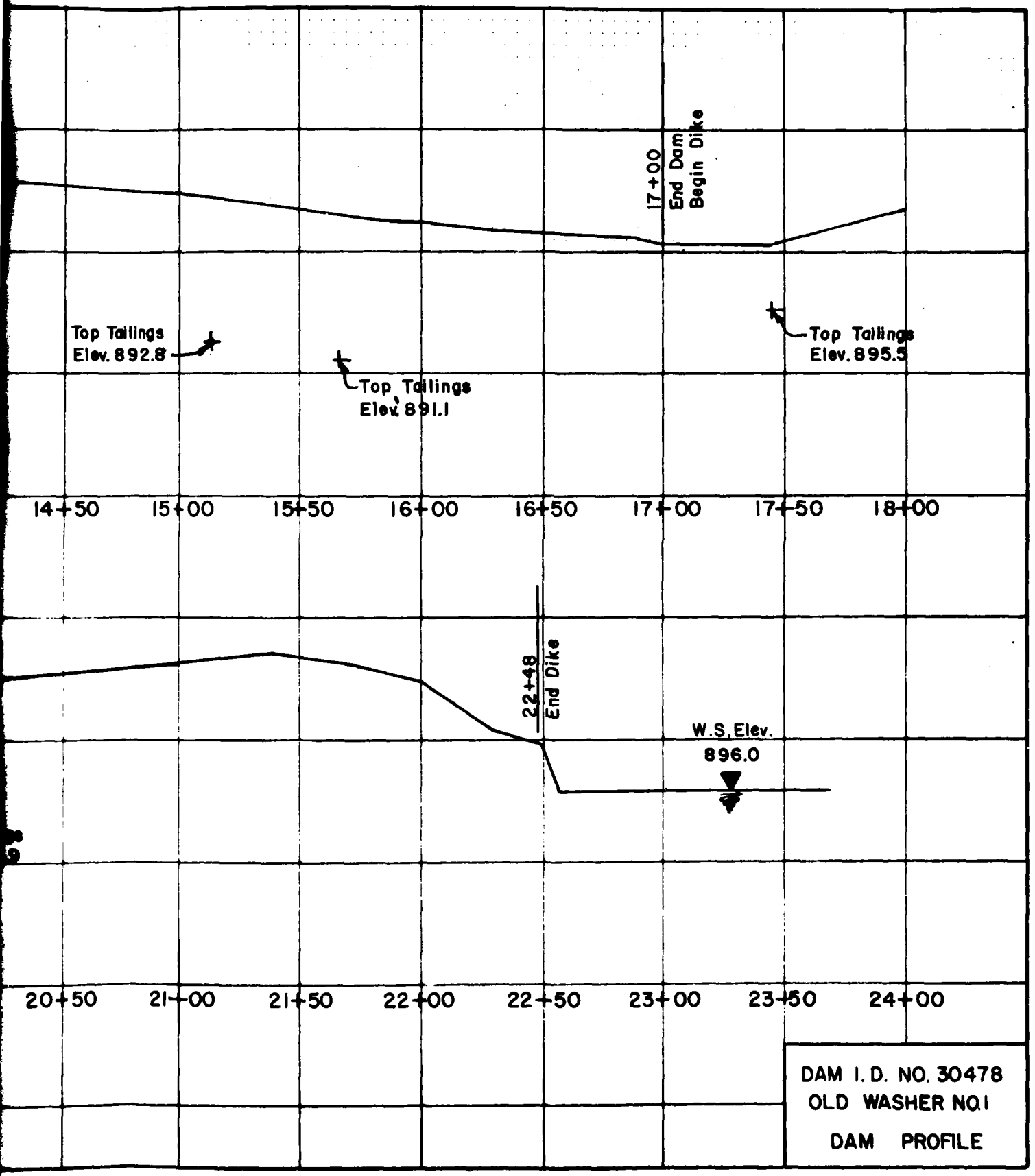
DAM I. D. NO. 30478
OLD WASHER NO. 1

DAM PROFILE

PLATE 4A

2


910
900
890
880
Top Tailings
Elev. 892.8
12+00
12+50
13+00
13+50
14+00
14+50
15+00
900
890
880
Top Tailings
Elev. 893.9
18+00
18+50
19+00
19+50
20+00
20+50
21+00



DAM I. D. NO. 30478
OLD WASHER NO. 1
DAM PROFILE

PLATE 4B

2

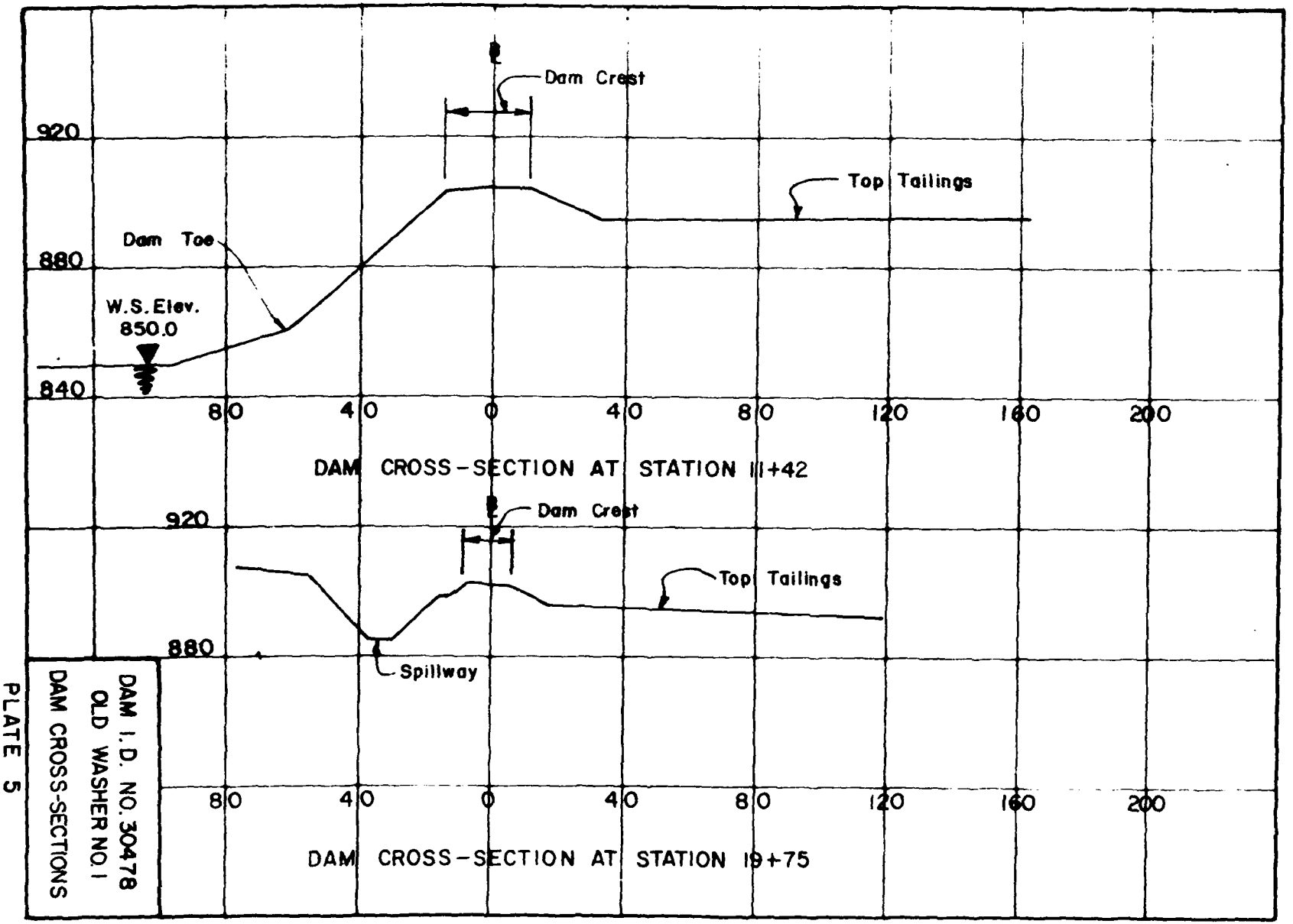
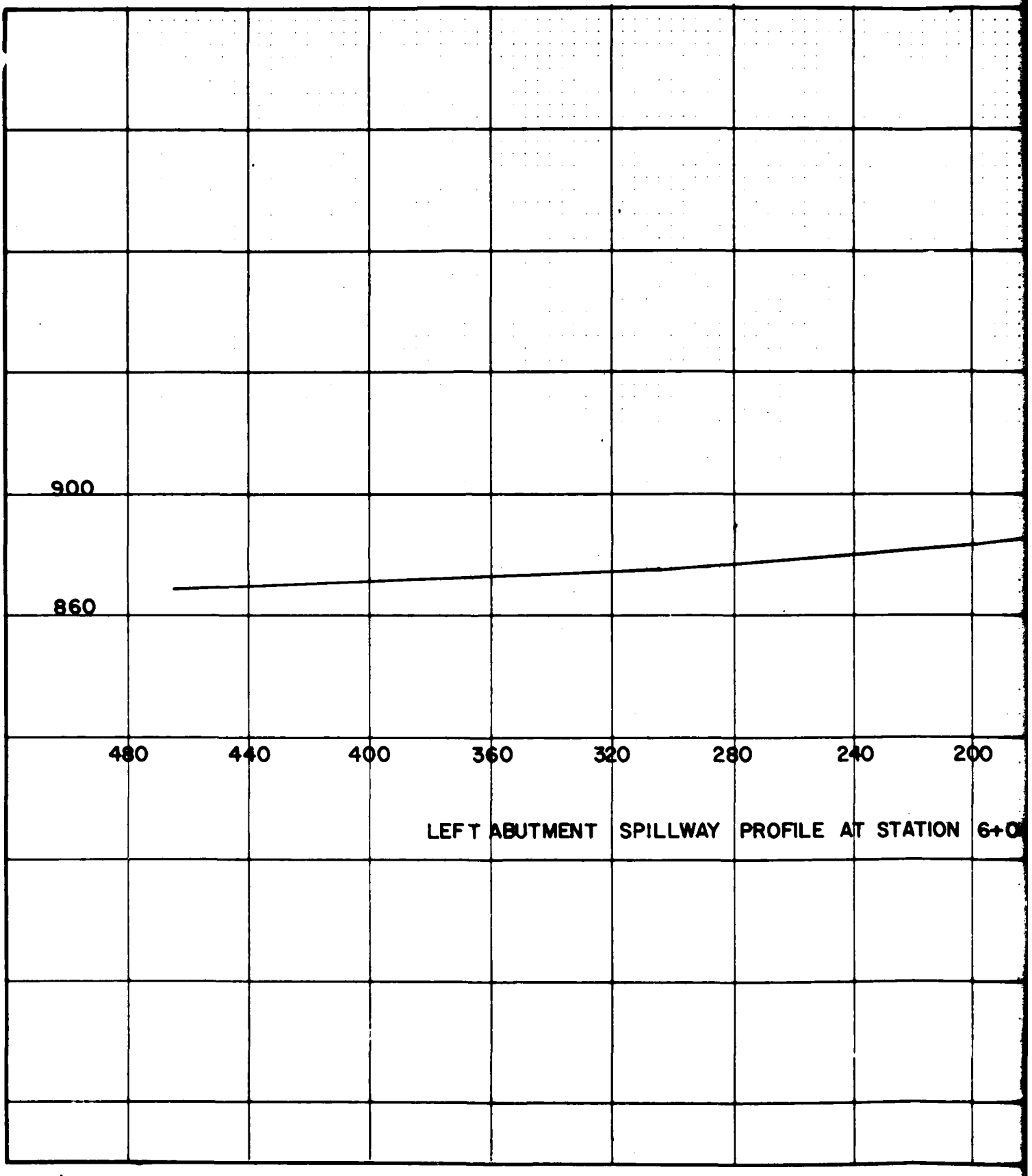
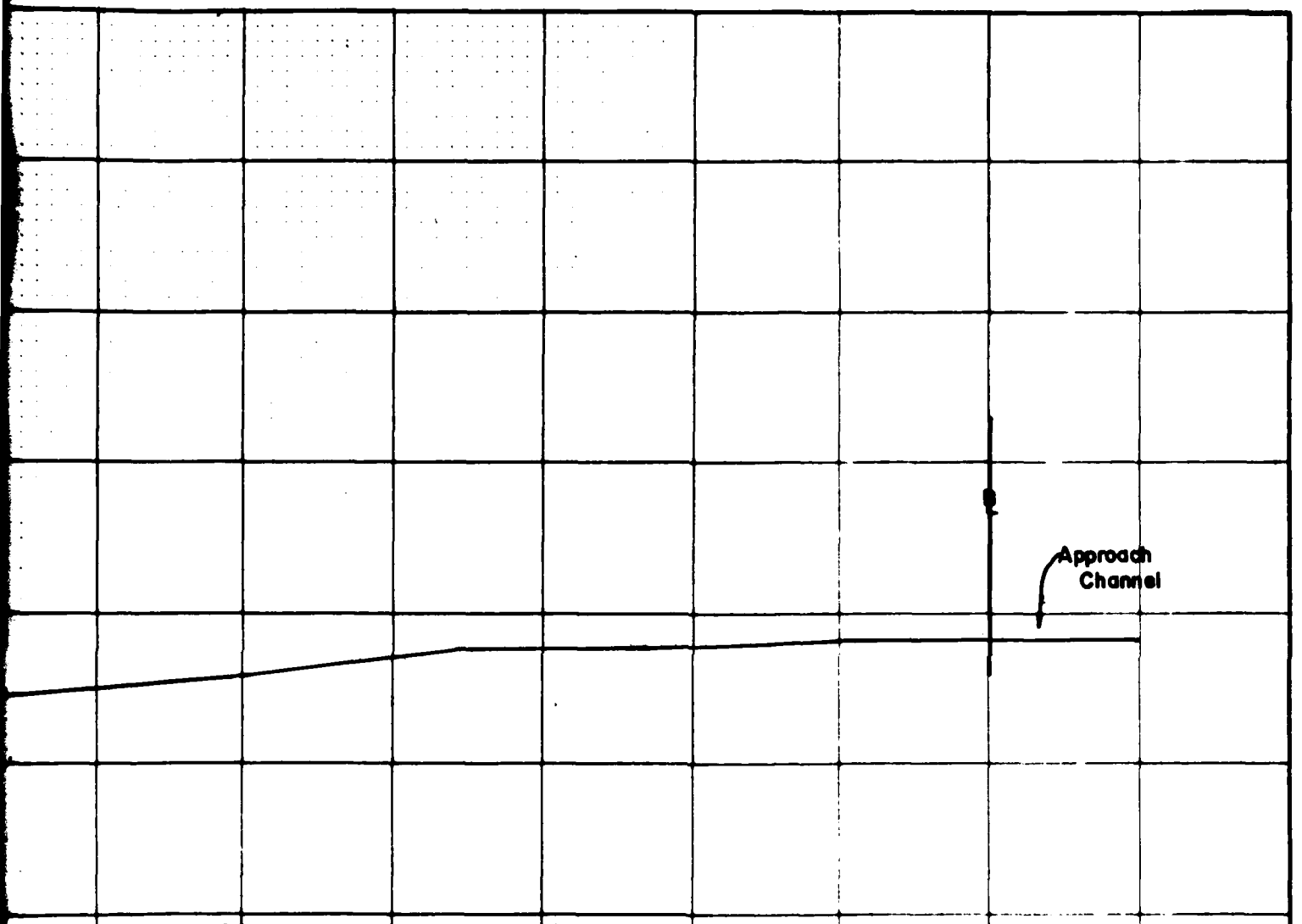


PLATE 5

DAM I.D. NO. 30478
OLD WASHER NO. 1
DAM CROSS-SECTIONS

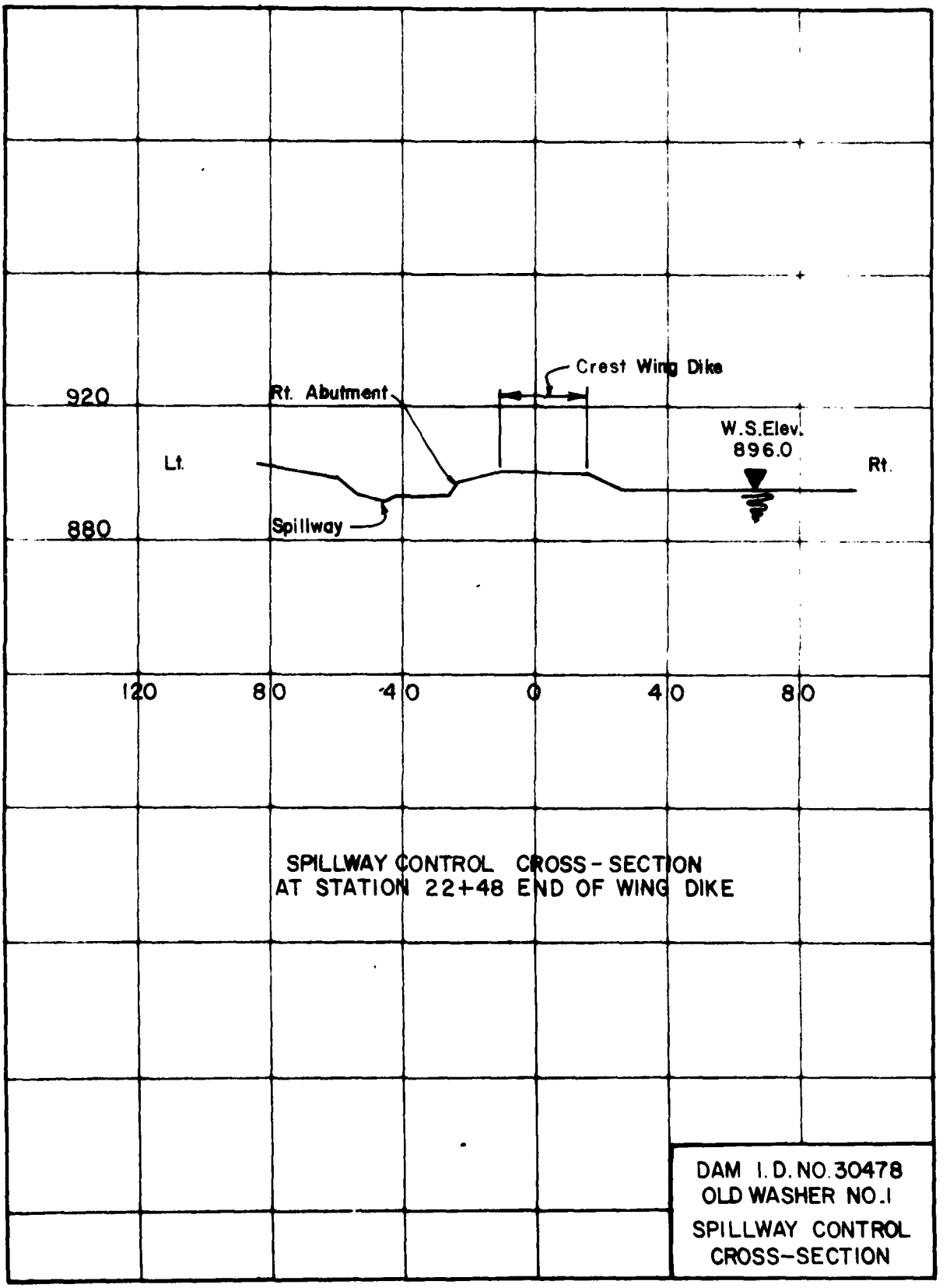

900
860
480
440
400
360
320
280
240
200
LEFT ABUTMENT SPILLWAY PROFILE AT STATION 6+0



FILE AT STATION 6+00 ℄

DAM I.D. NO. 30478
OLD WASHER NO. 1
LEFT ABUTMENT
SPILLWAY PROFILE

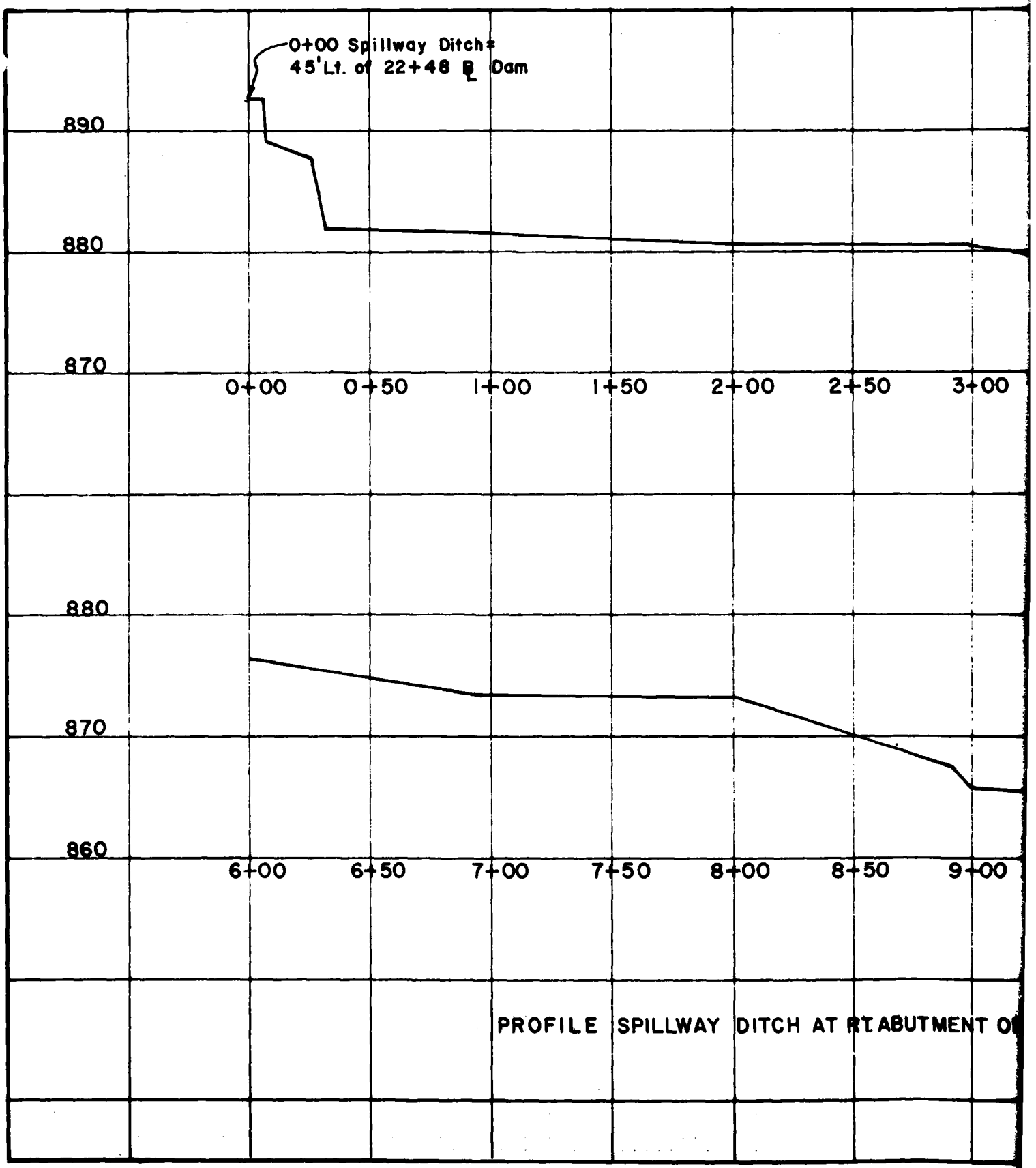
PLATE 6

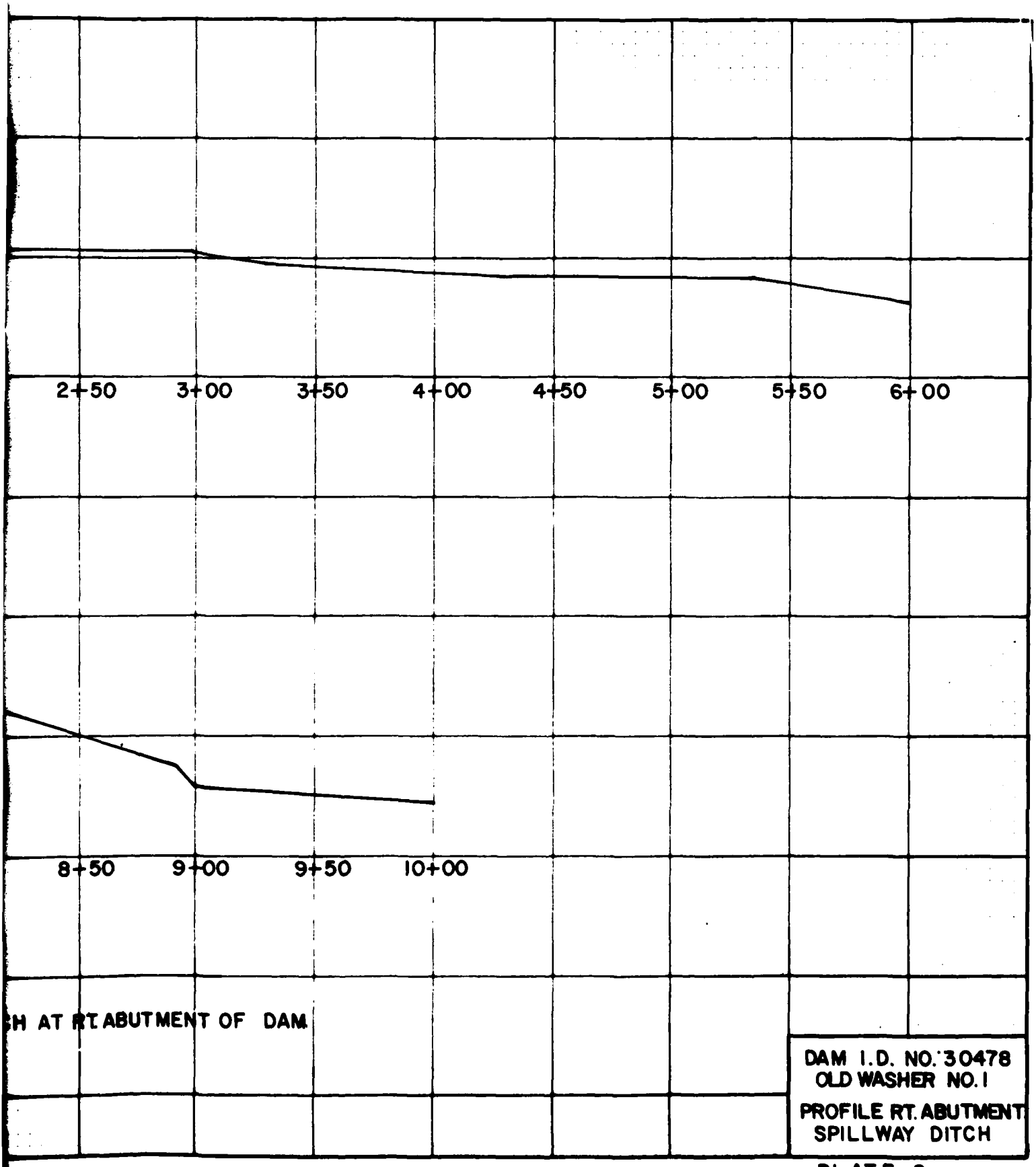


SPILLWAY CONTROL CROSS-SECTION
AT STATION 22+48 END OF WING DIKE

DAM I.D.NO.30478
OLD WASHER NO.1
SPILLWAY CONTROL
CROSS-SECTION

PLATE 7


0+00 Spillway Ditch=
45'Lt. of 22+48 ℄ Dam
890
880
870
0+00
0+50
1+00
1+50
2+00
2+50
3+00
880
870
860
6+00
6+50
7+00
7+50
8+00
8+50
9+00
PROFILE SPILLWAY DITCH AT RT ABUTMENT O



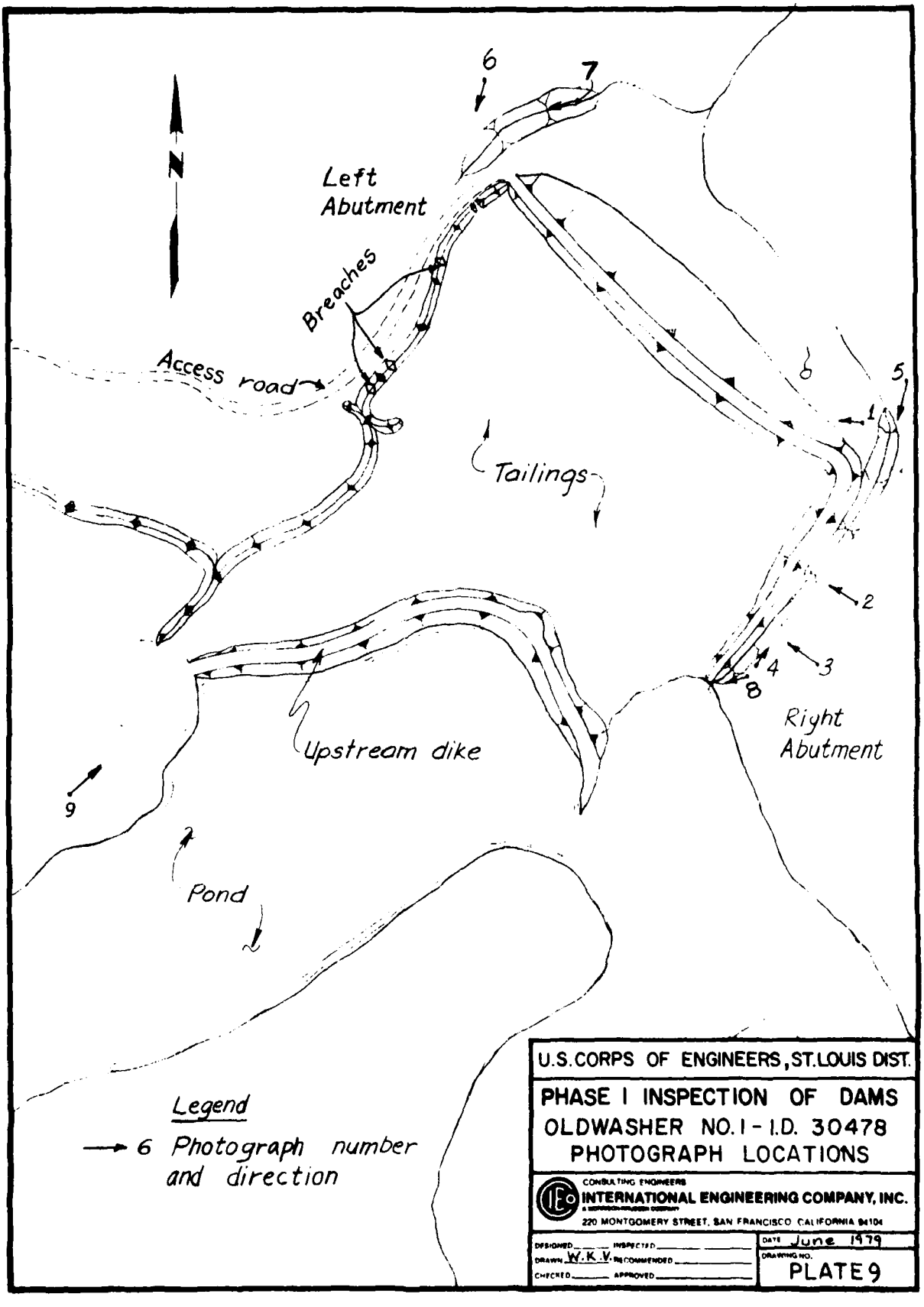
H AT RT ABUTMENT OF DAM

DAM I.D. NO. 30478
OLD WASHER NO. 1

PROFILE RT. ABUTMENT
SPILLWAY DITCH

PLATE 8

2


N
6
7
Left
Abutment
Breaches
Access road
Tailings
5
1
2
3
4
8
Right
Abutment
Upstream dike
9
Pond
Legend
6 Photograph number and direction
U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.
PHASE I INSPECTION OF DAMS
OLDWASHER NO. 1 - I.D. 30478
PHOTOGRAPH LOCATIONS
CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
220 MONTGOMERY STREET, SAN FRANCISCO CALIFORNIA 94104
DESIGNED
DRAWN W.K.V.
CHECKED
INSPECTED
RECOMMENDED
APPROVED
DATE June 1979
DRAWING NO.
PLATE 9

PHOTOGRAPH RECORD

OLD WASHER NO. 1 DAM - I.D. No. 30478

Photo No.	Description
1.	View of dam from right abutment.
2.	View of portion of landslide at dam station 19+00. Photo taken April 20, 1979.
3.	View of erosion and undercutting at dam station 21+00.
4.	View downstream of right abutment spillway.
5.	View upstream of right abutment spillway. Note rubber tire retaining wall in channel wall.
6.	View of station 6+20 of dam. Note location of spillway control section and gravel dike in background. This photo was taken on April 8, 1979 before erosion occurred.
7.	View upstream of left abutment spillway channel.
8.	Inlet to right abutment spillway.
9.	Reservoir and tailings pond. Dam is in background.

1

2

3

4

5

6

7

8


DA
FIL